ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

December 10, 1921

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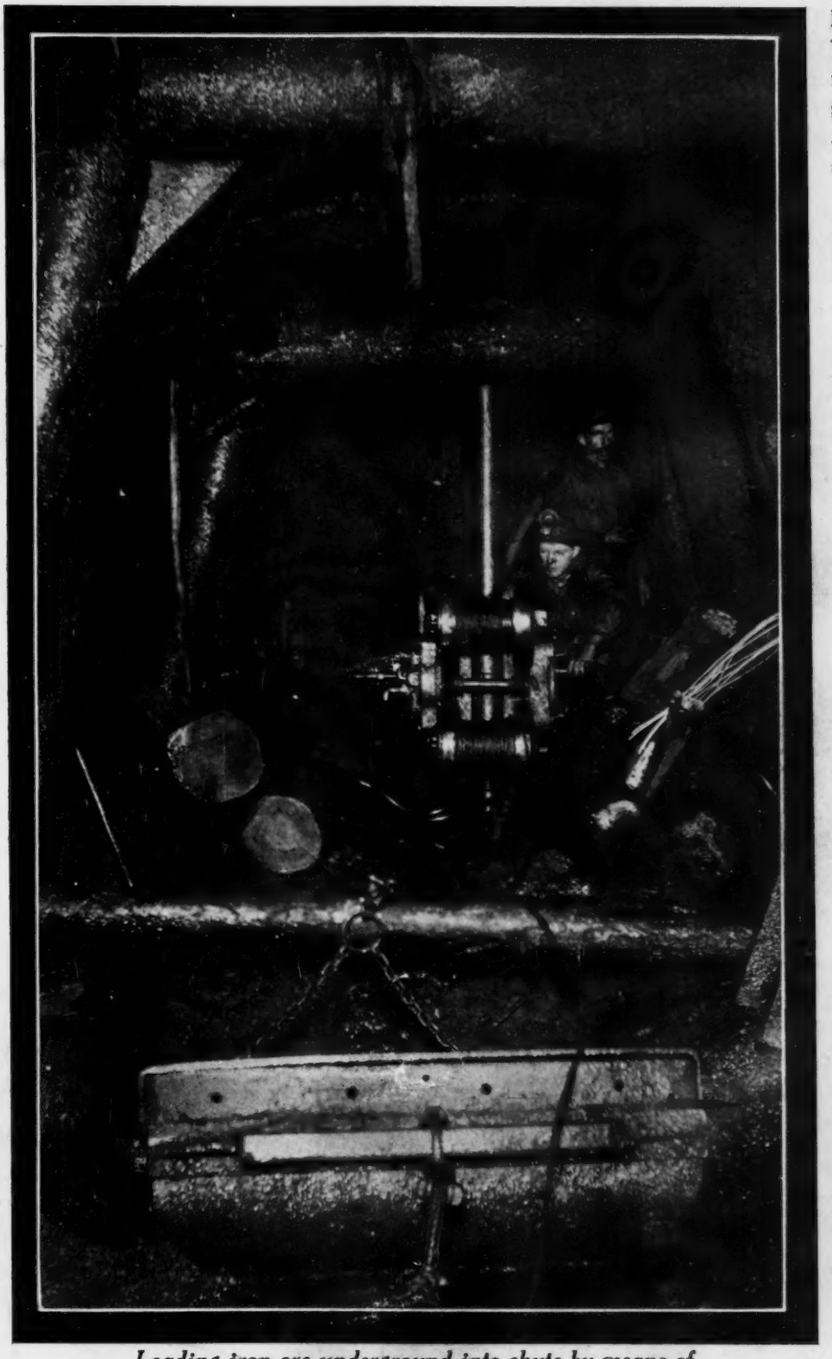
The petroleum resources of the world include potential supplies in almost every country. An interesting study of an unfamiliar oil district.

The Djambi Oil Field of Sumatra
By A. H. Redfield



Loading iron ore underground into chute by means of scraper and small-type hoist

Notable advances have been made in mechanicalization of underground methods. First article of an important series appears herewith.

Scraping and Loading with Small Compressed Air Hoists—I
By Ward Royce

The annual report of the investigations conducted by the Bureau of Mines has been submitted to Secretary Fall. This contains a record of the studies made along the direction of improvements in mining and metallurgical methods. A review of the report appears on page 944.

The situation at the mines showed gradual improvement in November, though most of the copper camps remained down. Activity was marked in the zinc and lead-producing districts of the Middle West. Distress from unemployment was nowhere acute. Conditions reviewed.

Recent Advances in Gold Dredge Bucket Lips, by George J. Young

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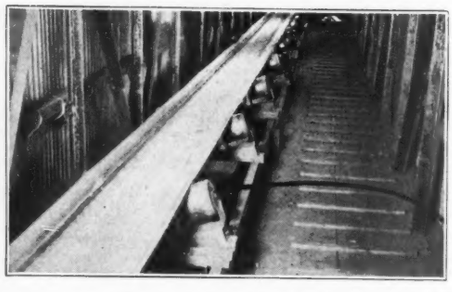

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The Future of Mining

FIFTY YEARS AGO new mining camps were being opened up everywhere through the West. Twenty-five years ago we still had little idea of the limits of our mineral resources, which appeared endless, and so we believed them. Have we grasped what has been going on in the last ten years? Mining has gone on actively; a great reinvigoration of mining activity has been gained by the development of vast low-grade mines, of a tenor previously scorned, especially of copper; and with less success, or with failure, of those of gold. Dredging has made it possible to extract the last few cents of gold from placer gravels previously passed over as unworkable. Meantime, great organizations of capital, served by exploration, geological, and engineering talent, have been systematically sifting the country for new mines of low or high grade wherein to invest the funds they have reaped from the mines they have exhausted or are exhausting. Thousands of mines and prospects are examined, and perhaps one in a thousand or one in five thousand, if the investigators are patient enough, can be made to yield some profit.

It is the gleaners—so soon—going over the field. And there have been many of them, for there are many strong companies whose exploration departments have followed one another from preferred mine to possible prospect. Some of our great companies have quit—abandoned their exploration departments and contented themselves with what they have, giving up the idea of replacement, and perhaps embarking their surplus capital on other lines of business.

Does this mean that mining is on the decline, and that it will disappear? Not so. The world is still fresh for the miner, in many vast areas. It means that our strenuous American mining enterprise must follow the lead of the British, and look upon the globe as its field. It means that our Government must recognize that the sphere of American mining enterprises, which is to feed the demands of our population, is in any and all foreign countries, and is to be followed and protected and fostered there as much as at home. Mining will not die. More and more the world will need the metals. But we shall see world shortages, one after the other, in the ores of many of the metals, *of the grade now exploited;* and consequent necessity of new methods and working lower and lower grades of ore.

In anticipating the great revival of mining which will take place with the restoration of a peaceful growing civilization to the world—and we trust that will soon be brought about—we must look to areas outside of Europe and the United States as better hunting grounds than our old ones have now become—to Arctic America, Latin America, Asia, and Africa. And the company that specifies that it will be interested only in mines close to transportation, and where the climate is right, and not too far from New York or London, will be left in the rear of the procession. Transportation was very bad to California, the Comstock, Guanajuato, and the Klondike when they began to be worked. If there are great mines to be opened up yet—and there are—it is because the going has been less good to them than elsewhere.

To the pioneer and the trail breaker belong the future, as the past, of mining.

Decreasing Costs of Production

NO DOUBT many of our readers living in the larger cities have had the pleasure of hearing Mr. B. Seebohm Rowntree speak on the problems of industrial management during the last two months. Mr. Rowntree is at the head of a cocoa works in York, England, employing 7,000 men and women, and which has not suffered from a strike in thirty-one years. He is a most attractive speaker and impresses one with the logic of his arguments. American business men, Mr. Rowntree says, have no equals in their zeal to adopt the most efficient machines and processes, and have no hesitancy in scrapping the most elaborate plant if a saving in cost can be shown. On the other hand, he feels that often much greater savings can be made by securing greater co-operation between plant managers and operators. (We do not like the term "workers"; for the man who sits at a mahogany desk works just as hard and gets just as tired, and does, moreover, just as necessary work, as the man who dons the overalls.)

The success that Mr. Rowntree has had in working out his ideas in England, the amount of study he has given to the subject, and the consultations he has had with men like Lloyd George and Herbert Hoover merit our attention. As to wages, he believes that the minimum wage paid to a married man should be sufficient to house, feed and clothe him and his family comfortably, to take care of normal running expenses, to provide a modest amount for entertainment and savings, and to provide for the education of two or three children. This is the principal feature in which our present system falls down, in Mr. Rowntree's opinion, and he stated that he was not even able to pay such a minimum wage in his own plant. Forty-eight hours of work a week should be given for the above wage. This seems just to us, for normal conditions where the employee is not compelled to waste time at work, or getting to and from his work.

The economic position of the employee was also dwelt on. Unemployment is often the big bugbear, and were a man assured of constant employment, he would be willing to accept a lower wage scale than otherwise. Attempts should be made to prevent seasonal lay-offs in certain industries. Other work should be substituted where possible and the employees trained to do more than one thing or sent to other districts where conditions are better. The unemployment insurance law in

force in England Mr. Rowntree believes to be a good thing, despite the unfavorable reports of its operation which sometimes reach this side of the water. He pointed out that equally unfavorable reports of our prohibition law are current in England, but since coming here he had found only two prominent business men who were not in favor of it, compared with the loose control of liquor distribution which obtained before the law went into effect.

But we are digressing. About three and one-half per cent of the wage bill in England goes to provide unemployment insurance. However, as Mr. Rowntree said, the amount is variable according to conditions, and it may also be raised in different ways, from the government, employer, or employee. In case of unemployment, fifty per cent of the regular wage is paid to a single man, with, we believe sixty per cent to a married man, and further increases where there are children. He did not think that employees showed much inclination to shirk work to get the insurance. Possibly some scheme could be devised to prevent this, such as an investigation to determine whether an honest effort had been made to obtain work, or if it had been offered and refused.

The status of the worker in the plant was the fourth point of importance. The employee should not, of course, control the work, but he should have something to say about the methods of conducting it, and his advice and co-operation should be invited. Outside representatives of labor unions should not be barred from the right of consultation. Finally, the employee should share in the profits of the enterprise to the extent, so far as practicable, that his increased efforts have contributed to such profits.

Mr. Rowntree's ideas have been embodied more fully in a book which he has written, "Common Sense in Business." Many of his arguments are those of the idealist, and, as he frankly stated, he has not yet found it possible to apply them even in his own plant. But they are the things we should seek gradually to bring about, in order to have the fullest co-operation between the groups known as Capital and Labor, and consequently the most economic methods of production. If Americans are backward in their study and application of these or other modern precepts for the conduct of business and production it is high time we gave them more attention. Perhaps we have been too wont to wave them away with the remark that they are not practicable. Very well, then, make them practicable!

Mechanical Loading Underground

IN THIS ISSUE we are publishing the first of three articles which cover in a complete manner the application of small-type compressed-air hoists to underground loading. In combination with various types of scrapers or "slushers," the use of the small hoist is beginning to play an important part in the operation of "mucking," for not only has it been possible to secure a greater tonnage thereby but a lower cost as well. The subject has been thoroughly studied in copper, lead, zinc, and iron mines, and the application of "scraper" systems to various methods of mining will be detailed.

Increasing costs for labor, supplies, and other expenses contingent to ore removal underground have made necessary the application of such mechanical devices as have been found suitable and economical, and these, together with the adoption of improved mining methods, have made it possible to keep production costs at a figure that will allow a profit to the operator. Formerly, the selection of a mining method was dependent almost entirely on the experience of the mine captain or other official in charge of the work, and the process of mine development proceeded in a fashion which was not always profitable, either from the standpoint of day-to-day production or the ultimate life of the mine. But the old order has changed, and today careful planning and systematic estimation of ways and means are considered essential before the adoption of a mining method.

The removal of ore from stopes, adequate support of workings, transportation of ore, and other considerations must have their place in the flow sheet, and the cost of each held to a reasonable proportion, if the development plan is to be a success.

We believe that the institution of scraper systems underground is a highly important development in the mechanicalization of underground mine work.

The Shyness of the Engineer

THE ENGINEER is notoriously ill at ease, awkward, and inept in public; he shrinks back upon himself and his profession. That stands in the way of his prominence as a leader, and ties him to the chariot of some man with no greater or with less ability, less command of facts, principles, and logic, but of more direct though cruder force, more versatile, fluent, and sympathetic with those moods of men which sway them more than reasons.

Of all the types of engineer, the mining engineer possibly has these characteristics most pronounced. Dinners are a terror to him if he imagines he may be called upon for a few words. His reason works best alone with facts: He thinks in the mine, or over the drafting board—not on his feet or eye to eye. He theorizes about his duty as a citizen, but makes little practical start at coming forward. Realizing his own small share in the universe, he is inclined to stand in awe of men of no heavier caliber than he.

It is a healthful sign of the times that our citizens, great and little, are tending more and more to chip in and do their bit cheerfully, whenever they see a chance to help out. You will note this earnest spirit everywhere—men of business, of affairs, of statesmanship, are democratic in their willingness to serve in small things, to be conferred with, to speak, to write, to fulfill all reasonable and helpful demands so far as they can. In a less measure this is true of engineers; and least of all perhaps of the mining engineers.

On going over a recent appraisal of leading engineers, a prominent technical journal discovered that of the mechanical and electrical engineers rated as the leaders all were occasional contributors to its columns. A survey of the corresponding mining engineers revealed the fact that many of them had never contributed out of their experience any written article to any publication. Their sense of brotherhood, of helpfulness, of service to their fellow-engineer was deficient. It is each man's duty, if he has had special experience, to share that experience, by writing and speaking, when he can—when he is requested, which is a fairly good rule, for he will not be asked unless his help is needed.

We have another example of this quality in the shrinking from publicity, in the refusal to have per-

sonal notices, photographs, or intimate sketches published. Those of us who are or have been in this frame of mind—and it is a very common malady with the most of us mining engineers—mistake, or try to pretend to ourselves that we mistake, our failing for a virtue. It is not a virtue: it is the fault of exaggerated self-consciousness. The man who is hungry for publicity, who maneuvers so that he may hear the sound of his own voice raised in public papers, so that he may see his name in print for the pleasure of feeling himself in the limelight, suffers from precisely the same malady —an exaggerated ego.

Your really balanced man—the man we all would like to be—has lost sight of his little self in the contemplation of swirling humanity, of many figures of men whom he respects, of the marvelously great universe around him. He has lost self-consciousness. He is no longer shy. He will speak if asked—or if he has an idea he will out with it without trepidation. It is all one to him whether his picture is published or not—if it will please anybody, ever so little, he is willing to help. If he can help by writing from his experience, or if anybody thinks he can help, well and good: he will write. But if no one wants him to write, if he has no conscious message, it is all one to him whether he never sees his name in print, or whether the newspapers are spotted with his name and doings.

He loves mankind, and is humble, yet is thankful for his ticket to the stage of life; he is determined, yet kindly; he wants to serve, in all things big and little. He does not pride himself on his modesty, nor does he pride himself on his ability to get on. He is not oppressed by his greatness, if he has risen to one of those little great positions which look so large to the man of narrow experience and of short perspective.

When some future city shall be to New York as New York is to Rome, as Rome was to Babylon—where then will be your little eminence? Verily, the future historian, a hundred years hence, shall not be able to locate thee with a fine-toothed comb. That time will come soon enough. Therefore, shed the oppressive robes of sequestered dignity, and get busy, and circulate freely while your little day is still bright. You'll be a long time dead.

Simplification of Manufactured Products

A MOVEMENT that may have far-reaching effects on many of the mineral-product industries had its inception on Nov. 15 in Washington at a conference called to discuss the possibility of reducing the number of varieties of paving brick now on the market. Invitations to the conference were sent out by the Department of Commerce at the request of the National Paving Brick Manufacturers' Association, and included representatives from the manufacturers, engineering and highway associations, and Government bureaus.

Remarkable progress was made, for the conference went on record as recommending that of the sixty-six styles of paving brick now manufactured, fifty-five are to be regarded as superfluous, eleven only being retained as standard. A representative committee of ten members was appointed to initiate any necessary subsequent changes. Highway engineers present expressed a willingness to write new specifications in accordance with the recommendations outlined, and manufacturers are committed to confining production of other than standard sizes to unfinished contracts, repair work, and special orders.

It is evident that such a wholesale reduction in the number of varieties will greatly simplify both manufacturing and road paving, and will materially reduce the cost of both operations. The advantages of such a step are so pronounced that the conference is to be congratulated on the result of its deliberations.

The importance of this movement can scarcely be estimated at this time; it may even mark a new era in manufacturing processes, for many other industries are considering similar simplification of products.

The active interest in evidence among various manufacturers tending toward a substantial reduction in the number of varieties of their products has led the Department of Commerce to seek an expert in such simplification of standards, who will act as a liaison officer to bring together all the interested parties in each particular group, to harmonize their various interests, and to assist in working out the desired reductions in sizes or styles.

It is a matter of particular interest that this movement, which may become nation-wide in its scope, had its real beginning in a basic mining industry. There is a wide field for similar adjustments in many other branches of mining, particularly in the non-metallics, where many of the final products are manufactured at the mine or quarry.

The outcome of future conferences of this character will be awaited with interest, and the hope is expressed that many of the leading mining men will follow such events from the conference floor rather than from the gallery.

Maintaining Healthy Miners

SANITATION at metal mines plays an important part in the routine of the operator's duties today. In a consideration of the various factors that go to make up an efficient organization it is recognized that "a contented workman is a good workman," and that every effort must be made to insure, so far as the company is able, a healthy body. Proper toilet facilities, change houses, drinking water, shower baths, and other equipment are responsible in large measure for the prevention of disease at mines; proper ventilation, instruction in hygiene, and the providing of suitable recreation may be mentioned as other means.

Earlier investigations of occupational diseases at mines showed an unusual prevalence of pulmonary tuberculosis, but of late years there has been a gratifying reduction of such cases. The U. S. Bureau of Mines, the National Safety Council, the National Tuberculosis Association, individual mining companies, and others have been making a continuous fight against the disease. But this work must go on.

During December the National Tuberculosis Association and its affiliated agencies are carrying on the fourteenth annual sale of Christmas seals. Briefly summarized, eight elements in the campaign to which the funds so obtained are applied are: Toward increasing the number of hospitals and sanatoriums; for establishing nearly 600 clinics and dispensaries; in securing at least 3,000 special tuberculosis nurses who instruct, in the home, mothers and their families; toward research work; for statistical study; for publicity in distributing during the last sixteen years approximately 1,000,000 pieces of printed matter; for the Modern Health Crusade which has enrolled nearly 6,000,000 school children who are learning daily health habits, and toward securing over 1,000 open-air schools.

WHAT OTHERS THINK

Side-Charging of Reverberatory Furnaces

The interesting editorial study of the "History of Side-Charging of Reverberatory Furnaces" in *Engineering and Mining Journal* of Nov. 26 calls to mind interesting phases in the development of Western smelting practice. One should bear in mind that the problems of fettling and charging were entirely separate, at least as far as practice was concerned, until the men at the Canadian Copper Co. discovered that a banked charge constituted a self-renewable fettling.

I can speak of my own knowledge of the changes in furnace design instituted by engineers with the Anaconda Copper Mining Co. Notwithstanding the fact that calcine tracks lie parallel with the furnace, charging was done through hoppers set across the Anaconda furnaces near the firing end. This method of charging was thought to be ideal, so the layout at Tooele—a smelter designed in 1909 by Charles H. Repath, mechanical superintendent of the Washoe plant—was for parallel tracks for coal and calcine, running overhead through the building at right angles to the furnaces. A similar track layout in the reverberatory plant was adopted by Messrs. Repath and McGregor in other Southwestern smelters designed by them from 1910 to 1914. No fettling holes were provided through the skewback in the original furnaces built at Tooele (1909-1910).

Having in view the possibilities of fettling through charge-holes, successfully practiced for many years at Cananea, I proposed a return to the Anaconda layout—double tracks over the furnace from end to end—in the preliminary design for the smelter reconstruction at Great Falls (1911). The very difficult topography of the site, and the desire to use standard-gage equipment and easy curves, forced a return to the then "standard" layout. In order to fettle through the arch, however, a narrow-gage track was laid on top of the brickwork of the furnace side walls, and a small hopper car transferred fettling matter from hoppers hung under the calcine tracks to the various drop-holes. This scheme was possible on the reverberatories designed under the direction of J. H. Klepinger, superintendent, and Peter Thill, master mechanic, and built there in 1912-1913, as these furnaces were cased in steel plate, and the arch thrust carried into a heavy slag foundation by inclined struts, thus wholly eliminating tie rods.

During the winter of 1913-14, experiments on pulverized-coal firing and side-charging were made at Anaconda, and were highly successful. By the summer time, at least one of the Anaconda furnaces was steadily smelting at a then unheard-of and extraordinary rate, with fine charge banked up on either side clear to the roof. Tiny rivulets of molten ore seemed to spring from the hot slopes. Hoppers were kept loaded, and charging was continuous. Necessity for fettling had gone, for the sides of the furnace were a bank of ore, constantly renewed. This was the logical extension of the idea which the Anaconda men freely attributed to the Canadians.

You should mention an interesting variation of the side-charging scheme as developed by James Heggie, then general superintendent of the El Paso plant of the American Smelting & Refining Co., and applied to reverberatories at that plant and at Hayden, Ariz. Originally built in 1912 as copies of the successful old Garfield long reverberatories, with a multitude of small buckstays, the Hayden furnaces were rebuilt to allow side charging through mangers some time previous to 1916. This involved piercing the side walls with broad, arched openings, requiring a buckstay spacing of about 9 ft. An inclined plate sloped outward and upward from the sill, forming the outer support of a heap of ore, converter slag and flux which entirely closed the opening. This cold material was always heaped high, and it rolled down into the furnace as the lower portions were smelted.

E. E. THUM,
Formerly Engineer, Great Falls Reduction Department,
New York. Anaconda Copper Mining Co.

The Horn of the Hunter

Prompted by your very praiseworthy effort to reduce the retail selling price of manufactured brass and copper articles to a level commensurate with the present wholesale price of copper metal, I wish to call your attention to the present exorbitant retail prices of shot-gun shells and rifle cartridges, in the manufacture of which copper and lead play the most important parts.

Shot-gun shells that sold at 70c. and 75c. per box of 25 in 1914 today cost the sportsman $1.30 to $1.40 per box, and cartridge prices show a proportionate if not greater increase.

Copper, as well as lead, for more than six months has sold below its 1914 pre-war price, and powder and mercury, I am told, cost no more at wholesale than previous to the World War.

Repeated requests made of our local dealers in ammunition for an explanation of these illogical prices have brought only the unsatisfactory reply, "We are not to blame for the prices."

Now, Mr. Editor, if you will make clear the reason for these high prices of ammunition, despite the low cost of those things that enter into its manufacture, and place the blame where it properly belongs, you will, I am quite sure, receive the thanks of a host of sportsmen all over the country. COLORADO SPORTSMAN.

Denver, Col.

Danger in Entering Old Workings*

In every abandoned shaft or pit, or in fact, any old working where the air has been stagnant for a considerable time, there is always danger of oxygen deficiency, as the oxygen which originally comprised one-fifth of the atmosphere may be appreciably replaced by gases that do not support life, usually by carbon dioxide (black damp) or methane (fire damp).

Generally, there is no physiological warning of oxygen deficiency in the air, the first decided feeling is one of extreme weakness, accompanied by dizziness, better described as partial paralysis, and the victim collapses practically without warning. To guard against this danger, a man should not enter old workings without having a rope tied around his body and at least two men on the top. The rope should be kept taut. Then if a distress signal is given, the explorer will not only be prevented from falling, but can be quickly pulled to fresh air and his life saved.

*Abstract of an article by B. O. Pickard, *Reports of Investigations*, U. S. Bureau of Mines.

Scraping and Loading in Mines With Small Compressed-Air Hoists—I

Use of Slushers in Underground Loading Applicable to Various Mining Methods—Direct Haulage to Chute Is Preferable—System Secures Greater Tonnage Per Man per Day and Combines Simplicity, Low First Cost, and Flexibility

BY WARD ROYCE

Written for *Engineering and Mining Journal*

DURING THE LAST FEW YEARS mining operators have been devoting considerable time to the solution of ore-handling problems. Previously advancement in the art of mining was mainly in the improvement in ore-breaking and rock-drilling machines, transportation and allied operations, but the "No. 2" shovel in the hands of a husky mucker has been the means of handling and loading most of the material broken in underground workings.

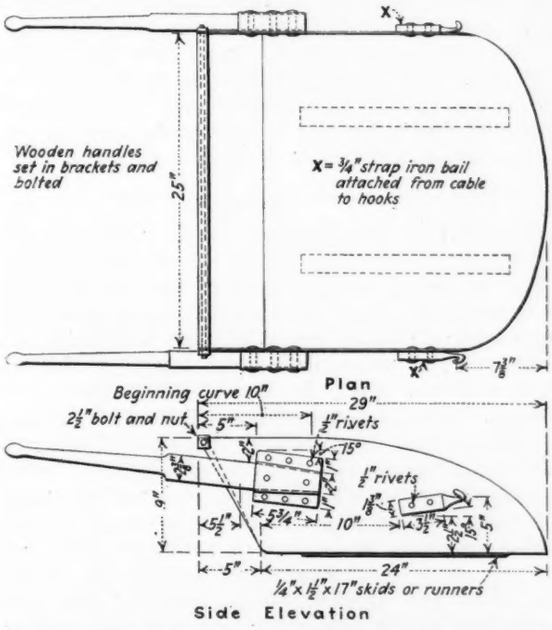


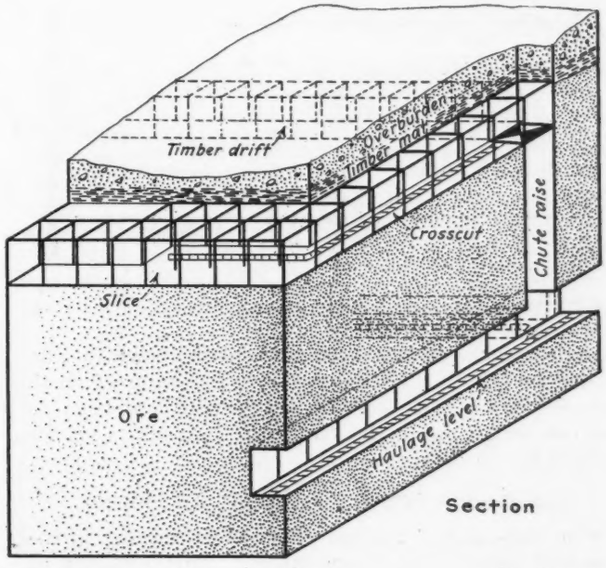
FIG. 1. OLIVER IRON MINING CO.'S SLIP SCRAPER

The obvious inefficiency in the use of the shovel and the increasing scarcity of the class of laborers required for the work have led to the development of a number of loading and shoveling machines, many of which are successful in the class of work for which they are designed and adapted. Machines of this class now on the market are practically all large and heavy, and of high capacity, and they require the services of operators of a higher grade of intelligence than is common among ordinary mine labor, and, in addition to first high costs, entail considerable expense incident to upkeep and repairs. Furthermore, their size, weight, and capacity limit their adaptability to utilization in the larger openings and most accessible places.

ECONOMICAL CONSIDERATIONS IN ORE LOADING

Time studies from various underground mining operations indicate that in the removal of ore by the old hand methods, mucking comprises from 25 to 50 per cent of the total shift's time. As there are only two men, as a rule, working in the average opening, this is sufficient evidence to show that the average working place does not produce enough material to allow economical operation of a machine of high first cost and large capacity, owing to the necessarily large proportion of idle time. Unless such a machine is sufficiently portable or flexible to permit of its being moved from place to place, and thus kept continually at work, or the time element and not cost is the first consideration, there can be no great advantage in its use in the average working place.

An excellent solution to the problem lies in the use of the scraper. The motive power for this type of ore-handling machine consists of a winding engine operated by air or electricity. The advantages in the underground use of an air-operated machine are too numerous to require detailed mention, the most obvious being the fact that in nearly all underground workings the power supply is already installed and available in the air lines upon which the machine drills depend. This type of



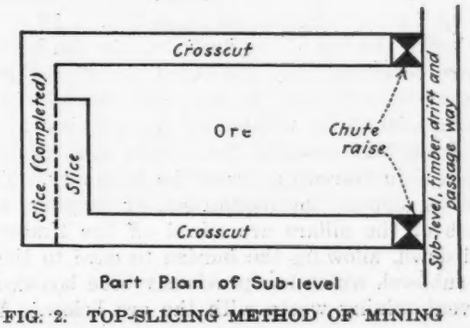


FIG. 2. TOP-SLICING METHOD OF MINING

machine has the further advantage of a design which in no way interferes with its variation in power, size, and portability with a corresponding variation in first cost and adaptability for other purposes, such as hoisting, hauling cars, and similar work.

The use of scrapers in mining merely involves the application of the several arrangements that have long been widely used in surface operations, varying from the horse-drawn slip scraper or "slusher" seen on every small grading job to the various drag-line scrapers and graders used in ditching, grading, and other large excavation work.

In applying the scraper to mining the simplest method comprises the combination of a small edition of

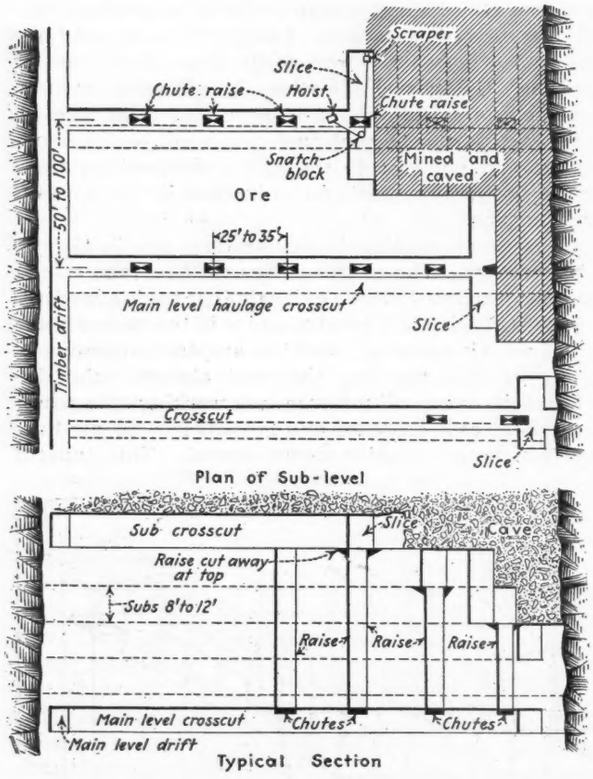


FIG. 3. TOP-SLICING METHOD ARRANGED FOR SLUSHING

the slip scraper or "slusher," such as is shown in Fig. 1, with a 1H "Little Tugger," or other type of small compressed-air hoist. This arrangement has been in use for some time in the "soft-ore" iron mines on the Mesabi Range of Minnesota.

Top-Slicing System Assures Clean Mining

The "top-slicing" method (Fig. 2) of mining is the standard practice at these mines. This consists of removing the ore in horizontal slices 8 ft. to 14 ft. thick, beginning at the top of the orebody. As the horizontal slices are developed they are called "subs" (sublevels). Usually on the sublevels the ore is divided by crosscuts into pillars 50 ft. in width, and by working at right angles from the crosscuts the pillars are removed in short slices in retreating from the boundary. Timber is used to support the overburden, or capping, and as the ends of the pillars are sliced off the timbers are blasted down, allowing the burden to cave to the floor of the sublevel, which has previously been boarded over to prevent mixing waste with the ore below. As the work progresses sublevels are opened from raises in the solid pillars, and removal of ore is carried on under the caved ground resting on the floor of the next higher sublevel. Eventually a mat is formed of the old timbers, which assists greatly in preventing runs of sand and other waste material. The ore is practically scraped off the floor boards laid in mining the sublevel above, and this results in remarkably clean mining.

The usual method of working with shovel and tram car called for only one raise to each pillar or working place, the raise being at the intersection of the sublevel crosscut with the haulage level drift below. This necessitated quite a long tram at the start of operations on the pillar, as the haulage drifts are usually on the boundary, or occasionally in the center, of the orebody. The more modern arrangement is to construct the chute raises at closer intervals along the sublevel crosscuts, connecting them with crosscuts on the haulage level parallel to and almost directly under the crosscuts on the sublevels.

The layout as arranged in the mines where slushing is employed is ideal (Fig. 3). Here the raises are located in such a way that each raise takes care of the ore mined from three slices. The ore from the center slice is pulled directly into the raise, and by blasting off a corner of the pillar the ore from the two outside slices is carried to the raise with little difficulty.

Distribution of Contract Charges

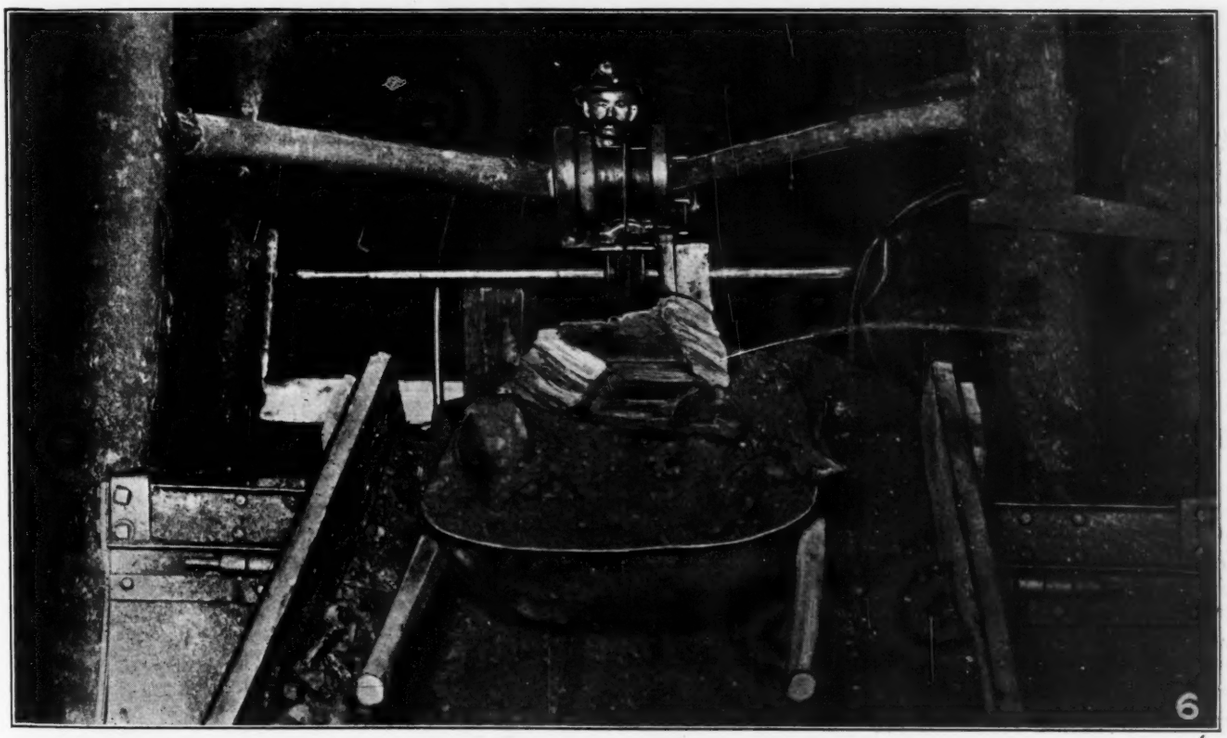
Miners work in contract gangs of four, two men on each shift, doing all the work connected with drilling, blasting, mucking, and timbering. Ordinarily, one gang is assigned to each crosscut and works both ways to the center of the adjoining pillars. The hoist and scraper are furnished to each gang, together with the drilling machine, steel, hose, and other permanent equipment. The men are charged only with shovels, saws, axes, and blasting supplies, the cost of this material being a charge against the contract, which is based on the number of cars loaded from the working place.

The "Little Tugger" hoist is usually mounted on a turntable which is made fast to a timber skid or a truck, the whole set being placed behind one of the chute raises and blocked down. One of the men operates the hoist; the other handles the scraper, carries it to the pile of broken ore, holds it by the handles at the proper angle as it is pulled into the pile by the hoist, and then follows the load as the scraper is hauled to the chute. Dumping the scraper at the chute (Figs. 4 and 5) is done in much the same manner as the horse-drawn scraper is handled on surface.

Although the labor of handling the scraper is fatiguing, the men change places at frequent intervals and have increased their production and earnings so that they are well satisfied with the method. When the scraper was first introduced there was considerable objection on the part of the miners, but since its advantages have been demonstrated the men request the equipment as soon as working conditions permit.

Snatch Block Used in Indirect Haulage

As a rule the workings are so laid out that the bulk of the ore is handled directly to the chute in a straight haul. If it becomes necessary to make a slight turn, the scraper is steered around the obstruction by the man who loads and follows it; where the turn is too abrupt it is customary to lead the rope through a snatch block at the turn. The scraper is then hauled to the turn,



METHODS OF USING SCRAPER

Fig. 4. Pulling scraper toward chute. Fig. 5. Dumping scraper at chute. Fig. 6. Loading cars with scraper over inclined slide

the rope removed from the block, and the haul continued to the chute. Similarly, a snatch block is used to direct the scraper to the chute when it is not convenient to set the hoist in line.

In certain sections of the mines where chutes are not accessible, cars are loaded directly with the scraper in much the same manner, the scraper being hauled up to the car over an inclined slide made of planks. This method (Fig. 6) is obviously a little slower than the other, but it gives satisfactory results.

The scraper now in use on the Mesabi Range holds approximately 3 cu.ft., and in handling the finer ore will carry and push along a total load of from 4 cu.ft. to 5 cu.ft. In hard chunky ore the efficiency is greatly lowered because of the difficulty of holding the scraper while it is being pulled into the pile.

A statement furnished by one of the iron-mining companies on the Mesabi Range and covering the production of about 40,000 tons of ore shows that twenty-four contract gangs using shovels and tram cars averaged 10.09 tons per man per day, whereas fourteen gangs using "Little Tuggers" and scrapers averaged 12.43 tons per man per day—an increase in production of 23.19 per cent. This covered all places where the scrapers were used. The most efficient operation is in performing work where direct hauls are possible and the scraper is dumped into a chute opening at the floor level. In 1921 conditions were greatly improved by modifying the layout in some of the new workings better to accommodate the scrapers. With these improvements the figures show more nearly fifteen tons per man per day.

Contract Earnings Higher Where Hoists Are Used

At the time these figures were compiled no great difference was made in contract prices to cover the cost of operating the hoists, the purpose being to promote the use of scrapers by allowing the men to make more money with them than they could by hand shoveling. The average difference in the contract price was about 5c. a ton, depending on conditions. Prices were lower in workings where the hoists were used, and the men in these stopes averaged about a dollar a day more than the men using shovels.

Two men using a scraper in the above-described manner should handle from 4 cu.yd. to 6 cu.yd. per hour of the soft, heavy ore, depending on the length of haul. The "Little Tugger" will haul the load at a rate of 80 ft. or more per minute, depending on the air pressure. Length of haul in these operations will probably average about 35 ft., the maximum distance being 50 ft., or slightly more under advantageous circumstances.

Considering the figures noted and assuming a wage of $5 per day, the labor cost per ton of ore is reduced approximately 10c., all of which has been saved out of the mucking time. The expense of operating a "Little Tugger," the power cost being as at the property from which the figures were obtained, should be about 75c. for handling the shift's output of twenty-five tons. The use of the scraper eliminates cars and track in the working places, with the labor involved in handling and rehandling track material. As the track has to be removed and relaid every time a slice is completed and blasted in, this becomes a considerable item. In addition, there is to be considered the reduction in final costs resulting from spreading the fixed overhead charges over an increased tonnage.

The efficiency of this method of handling ore with scrapers depends on several factors. The capacity of the scraper is limited to the size and weight of scraper that can be handled by one man without involving too much exertion. Length of haul is limited by the same factor, practice showing that efficiency is sharply reduced after the length of haul is increased beyond 40 ft. After this distance is reached the best results are obtained by using the scraper for car loading.

Advantages of Scraper Method

The principal advantages of the method are simplicity, low first cost, and flexibility. No rigging is required, operations start immediately after blasting, and the man carries the scraper directly to the most advantageous point. The clean-up is made without loss of time. The outfit is light and portable, and may be moved from place to place without much effort.

The principal disadvantage lies in the fact that it has increased the efficiency of the men without lightening their labor to a marked extent. Lightweights will accomplish little more with this type of scraper than they will do with a shovel, and in rough material they will probably do less. The method therefore has not disposed of the real problem of furnishing an outfit that anyone can use successfully.

Trolley Arrangement Effective but Inflexible

An ingenious arrangement devised to cut down the labor involved in the single-rope method of slushing is found in the trolley shown in Fig. 7. An I-beam carrying a small-type hoist at one end is mounted on a frame set up in the opening so that the end at the breast is higher than the other which carries the hoist. A pulley is mounted at the breast end of the trolley, and the rope runs from the hoist through the pulley, and then through another pulley carried in a traveler running on the beam. As the rope is wound on the drum of the "Little Tugger," the scraper is forced against the foot of the pile and loaded; then hoisted until the bail of the

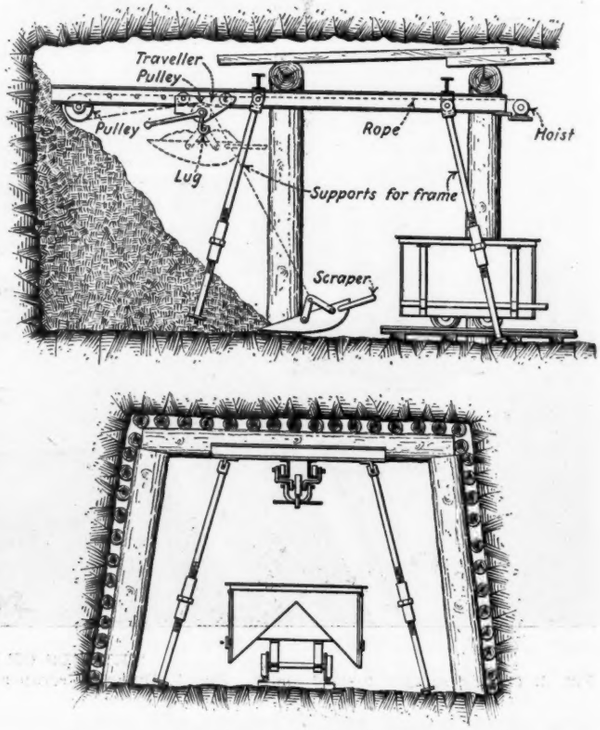


FIG. 7. TROLLEY ARRANGEMENT LOADER

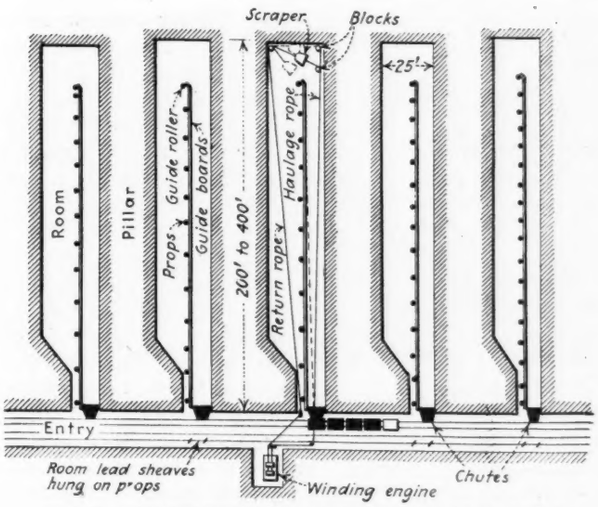


FIG. 8. EVANS SCRAPER SYSTEM IN A COAL MINE

scraper can be hooked to a lug on the traveler, when the rope is run slack and the traveler runs back down the inclined trolley, carrying the scraper to the point over the mine cars where it is dumped by tipping the handles. Two men operate the device, which has eliminated the labor involved in carrying the empty scraper. This is an improvement over the other method, but the inflexibility of the arrangement and the time and labor involved in extending the trolley as the opening advances, rigging and tearing down and other necessary work, have prevented its general adoption.

To increase the efficiency of the scrapers and further to reduce the labor involved, developments have been made which follow more nearly the practice covered by the surface drag-line outfit. This requires the use of a double-drum winding engine, so that the scraper is hauled by power during the complete trip, an arrangement for holding a pulley or snatch block through which the return rope may run, and the use of a scraper that is more nearly automatic in operation—i.e., self-filling and self-dumping.

Probably the first instance of the use of an arrangement of this type was in the coal mines of Pennsylvania. Here the Evans-Goodman scraper system has been employed for some time with considerable success.

True Scraper System Pushes Load

The winding engine used with the Evans scraper is a motor-driven, tandem-drum machine of about 25 hp., made by the Goodman Machinery Co., of Chicago. The drums have a capacity of 500 ft. of rope, and the rope speed is about 400 ft. per minute. The machine is 6 x 3 ft. and weighs from two to three tons. The scraper is a V-shaped device, 42 in. wide across the opening, 18 in. high and 36 in. long, made simply of a bent plate with a stiffener bar across the opening and carrying a piece of 3-in. angle part way around the bottom, which slips under the coal and provides a face for the scraper to ride on. This is a true scraper, as it pushes the load in front of itself instead of carrying the load, as is done by the slip scraper.

In practice the winding engine is set centrally to handle coal from a panel of four or five rooms. The ropes are led from the machine to a pair of guide pulleys mounted on a semi-permanent frame directly in front of the machine, and from them through such snatch blocks as are required to lead the ropes to the working faces.

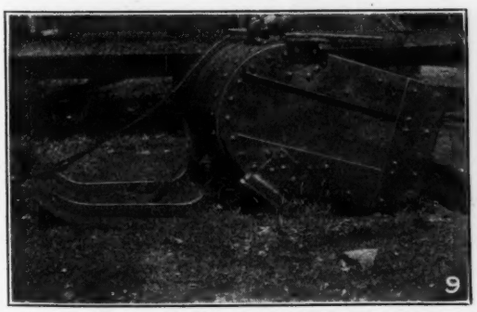
The rooms are ordinarily carried 25 ft. wide on 50-ft. centers and from 300 ft. to 500 ft. long, connecting one entry with another. A line of props is set along one side of the room, and to these planks, which serve as a guide for the scraper, are spiked. A snatch block is set at each side of the face and a vertical guide roller is mounted at the end of the line of guiding plank.

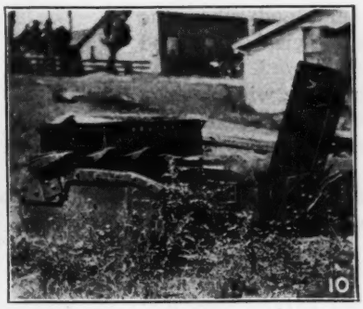
The scraper travels across the face of the chamber at the foot of the pile of broken coal. When the scraper approaches the side of the chamber the haulage rope is released from the near snatch block and the scraper is hauled along the line of guiding plank to the opening with the tail rope riding against the vertical roller. When the scraper is returned empty the haulage rope is again run through the near snatch block, so that the scraper again travels in a path parallel with the face. A removable chute apron of steel plate is provided at the mouth of the chamber to bridge the gap between the opening and the side of the mine car (Fig. 8).

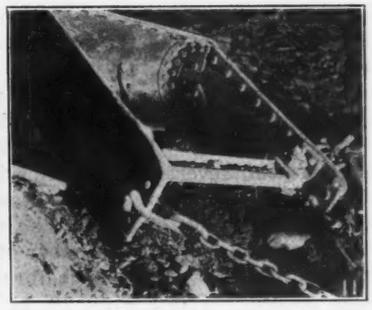
In mining the narrow beds it is necessary to remove either floor or roof rock in the entries to permit the passage of the mine cars. This requires that the chute apron be inclined to elevate the scraper to the car, where the roof rock is taken down and usually requires the removal of roof at the mouth of the chamber to provide head room for the scraper.

Evans System in Anthracite Field

I saw one of these scrapers at work in one of the mines in the Scranton anthracite field, working in a vein about 30 in. thick. The contractor in charge had a gang of nine men, who handled all the work in a panel of several rooms, using a Jeffry undercutter in breaking the coal. Drilling was done entirely with hand augers; all blasting, setting props, loading, and other work was on the one contract. The statement was







TYPES OF SCRAPERS

Fig. 9. Bagley grader. Fig. 10. Discarded experimental scrapers. Fig. 11. Quincy scraper in operation.

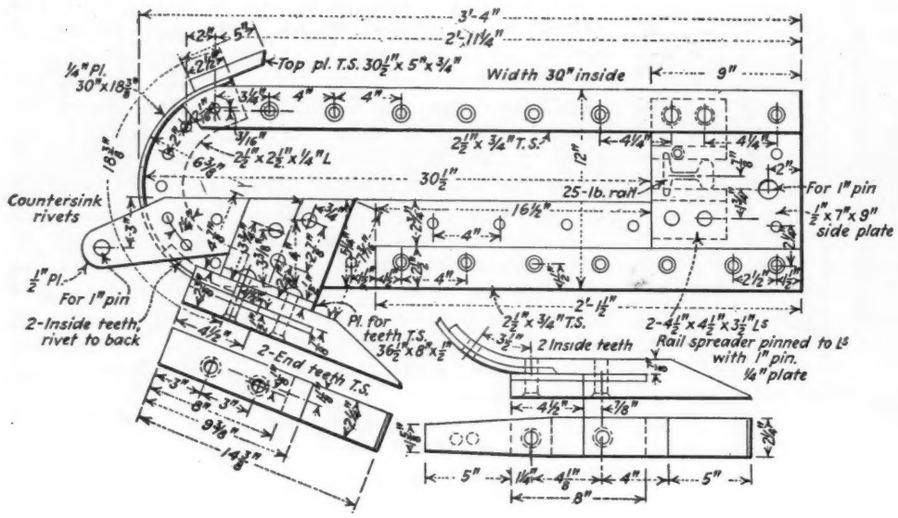


FIG. 12. QUINCY SCRAPER

made that the average daily production was about fifty tons of coal—roughly five tons per man. Low production may have been due to some extent to the fact that the men were working in such thin coal. However, the rooms were being carried over 300 ft. long, and it is probable that efficiency decreased because the men had to travel such long distances in transporting tools, timber, and other material, on hands and knees in very constricted quarters.

Several years ago conditions in the workings of one of the Lake Superior copper mines reached the point where it became necessary to devise mechanical means of removing broken ore from the stopes. The lodes outcrop at this property at a dip of about 50 deg., and for years the broken material would run freely on the foot wall. The lodes have gradually flattened out with depth, until the present openings are running on a foot wall with an average dip of about 35 deg., so flat that the broken material will not run. The ore, or "copper rock," is a fairly hard amygdaloid carrying native copper in shot, sheet, and mass form. The ore broken in the stopes is now hauled by scrapers to chutes at the drift level, where it is loaded into the mine cars.

Scraping as Adapted to Room-and-Pillar System

The stoping is laid out on a room-and-pillar system, advancing from the hoisting shaft to the boundary limits, the pillars being removed in retreat from the boundary. The haulage levels are driven at 200-ft. intervals on the dip of the lode, the stopes connecting level to level. In working out these flat stopes enough of the broken material is removed from time to time to permit the passage of the miners, and when the stoping is completed the remaining material is cleaned out.

Experiments were made at this property with various modifications of the Bagley grader and other similar power scrapers. These are box-shaped, bottomless scrapers of several yards' capacity,, used extensively in the West on grading and excavating jobs. (Fig. 9.) Such scrapers were found to be entirely too large for underground use, and a number of smaller machines of similar design were tried before the present scraper was adopted. (Note Figs. 10, 11 and 12). Patentable features of these scrapers, which had no application in underground work, were entirely eliminated.

The Quincy scraper is a bottomless box device of about 8 cu.ft. capacity, weighing about 500 lb., and made reversible with teeth on one side and a straight lip on the other to fit it for handling either coarse or fine material.

Winding engines in use are geared, double-acting, double-drum machines of about 20 hp., weighing from 2,500 to 3,500 lb., such as are made by the Lidgerwood Manufacturing Co. and other manufacturers. Several machines now in use were designed specially for this work by the Lake Shore Engine Works, of Marquette, Mich. The drums have a capacity for 300 to 500 ft. of ½-in. rope, and a rope speed of 200 ft. per minute. (Figs. 13, 14, 15.) All these machines are air operated.

The Use of Snatch Blocks

In opening the stopes the entire lode is cut away to a height of 15 ft. to 20 ft. above the floor of the drifts. Stulls are then placed skin to skin along the foot-wall

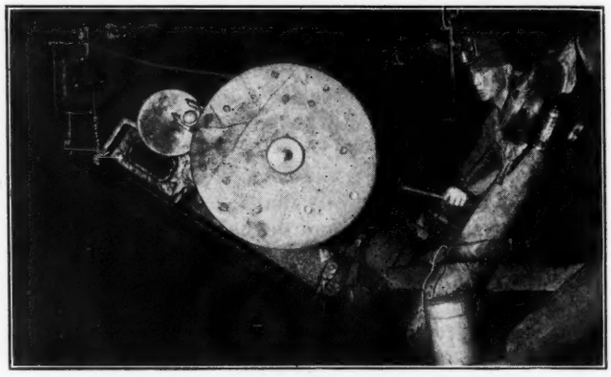


FIG. 13. SCRAPER ENGINE IN MICHIGAN COPPER STOPE

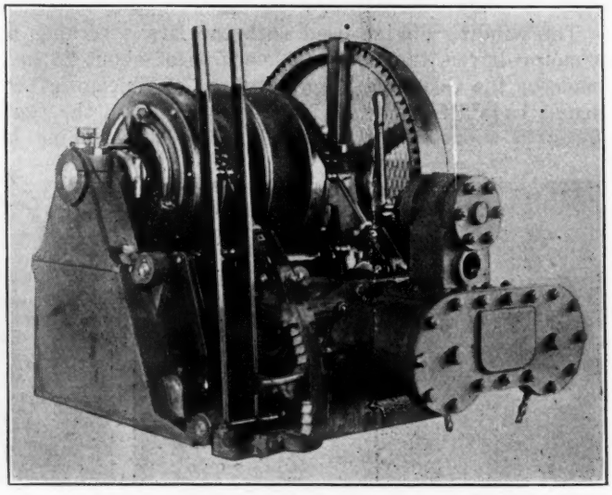


FIG. 14. LAKE SHORE ENGINE WORKS AIR-DRIVEN SCRAPER HOIST

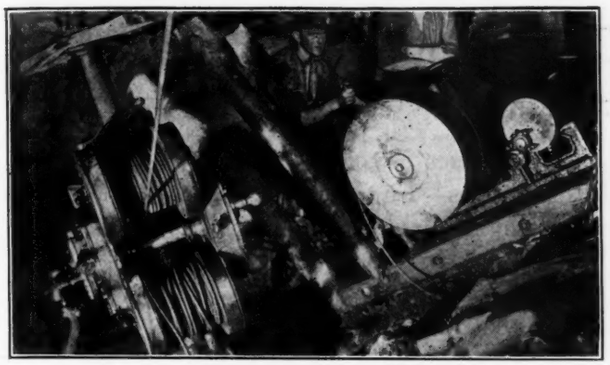


FIG. 15. 4H "LITTLE TUGGER" SCRAPER HOIST

side of the drift, leaving openings at regular intervals for the chutes. (Fig. 16.) The winding engine is set up on the foot wall above the stull timbers, at the foot of one of the pillars between the stopes. The ropes are handled much the same as in the Evans coal-scraping system.

One set-up handles the material broken in two or three stopes on each side of the machine. The snatch blocks are suspended from drill columns jacked in between foot and hanging, or from hooks set into holes drilled into the hanging wall. The ropes are usually led around a pair of guide pulleys set directly in front of the engine and from them to the place where the scraper is to work; one snatch block is hung at the top of the stope and another on the timber just above the chute, and the scraper operates between them. By changing these two blocks from one chute to another and from one point to another at the top of the stope, practically all the foot wall is covered and little or no shoveling is necessary to finish the clean-up. (Figs. 16 and 17.)

The scraper crew consists of four men—one handling

FIG. 16. CHUTE TIMBERING IN A COPPER MINE

the engine, two men who work along the path of the scraper, moving the large pieces of ore, shifting rigging, and performing other necessary work, and one man who acts as signal man and is stationed at or near the dumping point of the scraper where he can oversee all the operations.

Conditions Govern Output

Under favorable conditions four men will handle in this manner approximately 150 tons of the broken rock as an average day's work; they have handled as much as 275 tons in an eight-hour shift and as little as 75 tons. Quantity depends entirely on conditions. The day's run in the clean-ups is usually low. Under the old arrangement it would take many more men to handle this material by shoveling it down the foot wall from one man to another. In fact, the mine captain once remarked that he could not crowd men enough into one

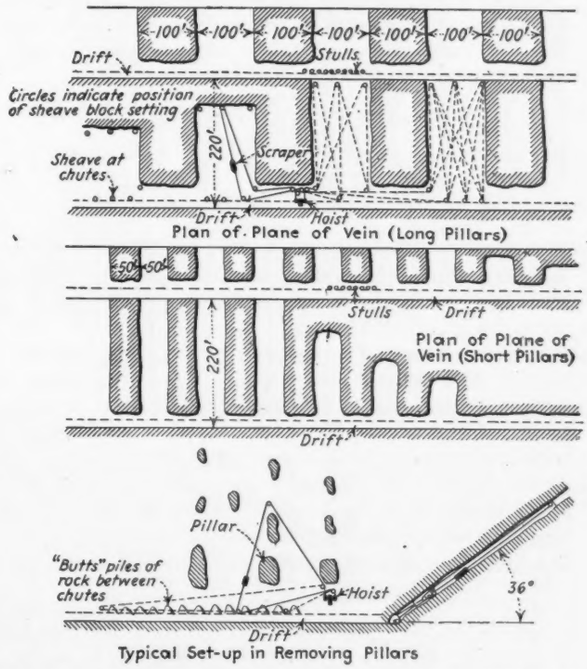


FIG. 17. SCRAPER SYSTEM ARRANGED FOR ROOM-AND-PILLAR METHOD OF MINING

of the stopes to get out as much as the scraper crew would handle.

To be continued

Bureau of Mines Releases Two New Films

The U. S. Bureau of Mines has recently added two new motion pictures to the list which it releases for educational purposes. One is "The Story of Heavy Excavating Machinery" in which are depicted the various types of steam, gasoline, and electric shovels and other apparatus of a similar nature used in mining operations. Scenes are shown in the iron mines of northern Michigan and the quarries of New England, as well as coal-stripping operations in Ohio. The picture was prepared in co-operation with the Bucyrus Co.

The other film is entitled "Mexico and Its Oil" and was produced with the aid of the Sinclair Consolidated Oil Corporation. Scenes in the inland oil fields and at Tampico are shown. Applications for the loan of these pictures should be made to the Bureau of Mines, 4,800 Forbes St., Pittsburgh, Pa.

Recent Advance in Design of Gold-Dredge Bucket Lips

Inside-Outside Type, Lately Developed, Possesses Several Advantages—Re-riveting Unnecessary During Life of Lips—Improved Reiling Lip Marks Return to Double Flange—Casting Teeth on Inside of Lip

BY GEORGE J. YOUNG
Western Editor, *Engineering and Mining Journal*

GOLD-DREDGE buckets and bucket parts have not been standardized, but each dredging company modifies bucket shape and parts to accord with the exigencies of its practice. The larger companies have two or three styles of bucket, all of which are interchangeable on the same boat. The weight of buckets is approximately 200 lb. per cu.ft. of capacity, the following table indicating approximate weights of buckets and lips:

APPROXIMATE WEIGHT OF DREDGE BUCKETS AND BUCKET LIPS

Bucket Size, Cu.Ft.	Weight Bucket Without Lip, Lb.	Weight of Lip, Lb.
6	1,095	195
7	1,400	260
9	2,100	450
15–20	3,000 to 3,900	570–750

Practically all buckets are now made of manganese steel and are of the two-piece pattern, the bucket base, with the eyes and the hood, being cast as one piece of manganese steel. The bucket lip is cast separately and riveted on. When gold dredges were first built, the bucket speed was 50 ft. per minute, but it is now, upon most dredges, 70 ft. per minute. Consequently, both buckets and bucket lips have to withstand more severe conditions. A manganese-steel bucket will last about three years, an 18-cu.ft. bucket handling in that time approximately 200,000 cu.yd. of gravel. Bucket lips last from six to twelve months, and in some instances up to eighteen months. Bucket pins have an average life of six to twelve months, but are more uncertain in length of life than other parts of the bucket line. Bushings of manganese steel last six to nine months. Bucket pins have been constructed of manganese steel, but these often have been uncertain in length of service. Properly cast and heat-treated, the manganese-steel bucket pin gives excellent service, but, owing to breakages, the nickel-chrome steel pin has been principally usd. Recently, however, better results than formerly have been obtained with the manganese-steel pins.

FIG. 1. ORDINARY OUTSIDE DREDGE-BUCKET LIP
Weight of bucket without lip or bushing is 3,583 lb. Bucket lip is 3 in. in thickness and is held in place by 1¼-in. rivets.

Bucket lips are subjected to the greatest wear and tear of all parts of the dredge bucket. The ordinary lip of the outside type is shown in Fig. 1. The lip shown takes up outside wear. The Reiling lip, shown in Fig. 2, which was first used by the French Gulch Mining Co., of Colorado, is known as the inside lip. The riveting flange of the lip is inside the bucket hole, where it forms a projecting ledge. This arrangement takes up inside side wear and provides a clearance that makes the bucket discharge more freely than one of the outside-lip type, in which the contents sometimes packs tightly, particularly where heavy clay accompanies the gravel.

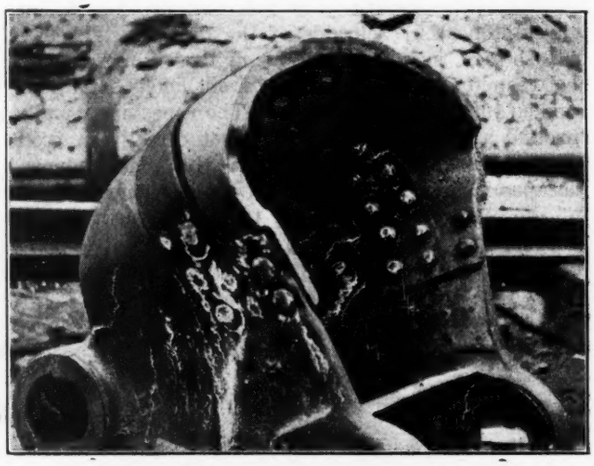


FIG. 2. REILING INSIDE DREDGE BUCKET LIP

Other minor improvements also have been made, such as the casting of one or more ribs upon the bucket hood to take the thrust upon the riveting flange of the outside lip, or the casting of a small projection on the bucket hood for the same purpose. To get greater freedom of discharge, in some instances the back part of the bucket lip abutting against the edge of the hood has been thickened, meeting the cutting edge in a sweeping curve.

THE "INSIDE-OUTSIDE" LIP DEVELOPED

Following the invention of the Reiling lip, a double-flanged bucket lip was developed. This lip had complete inside and outside riveting flanges. In principle it was an improvement over the various modifications, but it

was difficult to get an accurately fitting casting. The inside lip was next changed by placing one-third of the inside flange on the outside, making a lip riveted by a flange in part inside and in part outside. This was easier to fit. In the lip as finally designed, shown in Fig. 3 (1), the middle part is riveted on the outside and the ends are riveted on the inside. This type of lip is called the inside-outside lip.

The advantages which have developed in the use of the inside-outside lip over the old type outside lip are more pronounced in difficult digging, as when in cemented gravel and in material where boulders and clay are encountered. In loose material, however, the advantages are sufficient to warrant the use of this type of lip. It is not necessary to make any change in the design of existing buckets, as these lips can be used by changing the lip pattern to fit any bucket of the present type. In fact, the advantages of this new type of lip show up more quickly on a partly worn-out bucket.

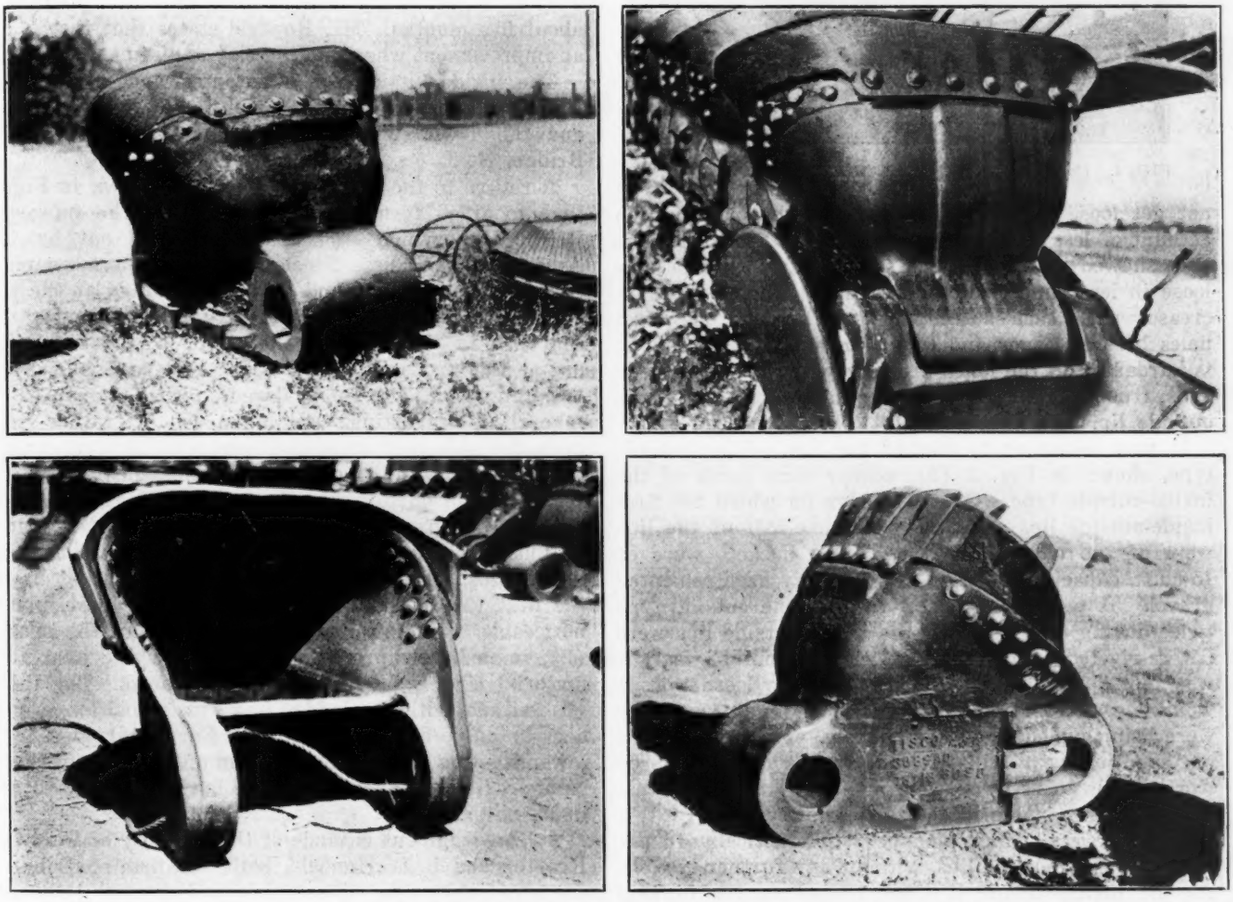


FIG. 3. (1) INSIDE-OUTSIDE LIP WITHOUT TEETH. (2) CLOSE-UP VIEW OF BUCKET, SHOWING WORN HOOD OF BUCKET WITH INSIDE-OUTSIDE LIP ON. (3) OUTSIDE LIP. (NOTE LIP PULLED AWAY FROM HOOD AT SIDE ON BUCKET.) (4) SIDE VIEW OF BUCKET AND LIP WITH TEETH CAST ON

RE-RIVETING OF BUCKET LIPS ELIMINATED

The necessity of re-riveting during the life of the lips is eliminated in the use of the inside-outside lip. It was necessary, with the old-style lip, when working under conditions similar to those in some of the dredging fields in California, to re-rivet the lips every four or five months. This is an expensive operation, necessitating, as it does, the shutting down of the dredge to change the buckets. The chief cause of the rivets working loose is the pressure at the top or center of the lips as they are forced into the bank while passing under the lower tumbler. This, in addition to the pull that comes on the ends, or corner, of the lip as the dredge is swung sideways, tends to make the ends spread. This puts the rivets in tension and causes them to loosen rapidly, the rivet holes in the hoods of the buckets wearing larger each time the lips are re-riveted. With the inside-outside lip, however, the tension on the rivets is taken care of by the flanges. At the center of the lip the flange is on the outside, which takes the pressure when the bucket is forced into the bank under the lower tumbler. The flanges at the ends of the lip are on the inside, which prevents them from spreading out from the pressure at the center and the side pull on the corner at the same time. Consequently, the rivets do not come into tension, which fact prevents their working loose as quickly as they did with the old type. The rivets will not stay tight under all operating conditions, but the lips will not come off even when the rivets are loose.

The inside-outside lip prevents the hood of the bucket from wearing out, as the flange protects that portion on the inside where the most wear comes on the hood. According to L. D. Hopfield, the new lip was first tried out and used to salvage buckets which had worn on the inside at the side or circular part of the hood shown in Fig. 3 (2). The flange of the lip at this place was put inside of the bucket and serves as a patch for the hood. It developed that these lips did

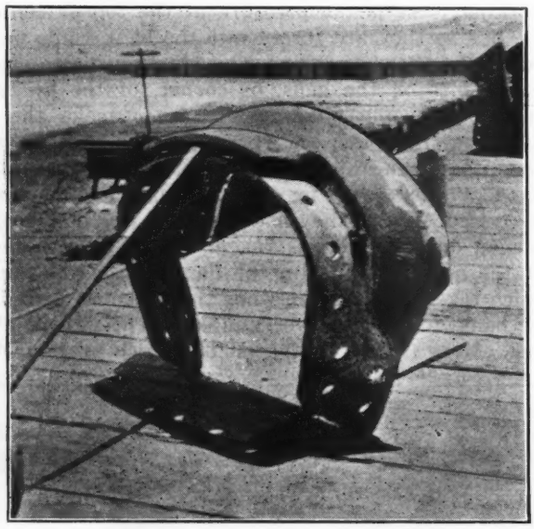


FIG. 4. IMPROVED REILING DREDGE BUCKET LIP

not get loose as readily as those of the old type, on account of less wear in the holes of the hood. Experience showed that the second set of outside lips became loose in less time than the first set. This trouble increases with each succeeding set, because the rivet holes become larger and irregular in shape, so that it is harder to fill the holes properly with the new rivets. This trouble is practically eliminated by the inside-outside lip.

It was necessary to discard the lips of the outside type, shown in Fig. 3 (3), sooner than those of the inside-outside type. On the dredge on which the first inside-outside lips were tried out, one-half of the lips were of the old outside type. The buckets were of 15-cu.ft. capacity and were digging very hard cemented gravel. It was necessary to re-rivet the outside type twice during their life, but the inside-outside lips were not re-riveted. At the end of eleven months' wear, it was found that the outside lips were so loose that it would be necessary to re-rivet them again, as they were being pulled off of the buckets. There was about one month's wear still left, but it was not considered worth while to re-rivet them again, so they were discarded. The inside-outside lips, however, gave this additional wear, which amounted to practically 10 per cent of the life of the lips, without any further trouble. As the inside-outside lips are placed on the buckets from the front, they are much easier to put on and it is possible to get a much better fit.

With this type of lip, Mr. Hopfield also states, there is less spill back into the well hole at the main hopper. When the bucket dumps its load on the back of the preceding bucket, some of the material, as it slides along the back and over the sides of the bucket, is sufficiently deflected when it hits the projection of the outside lip, to cause the material to fall back into the well hole. The inside-outside type is flush with the surface of the bucket hood along the sides and allows the material to fall into the hopper and pass through the screen, resulting, no doubt, in quite a saving of gold during a year's operation.

It was first thought that the inside flanges of the new-type lip would interfere with the proper discharge of the material, if it were of a sticky nature. This, however, has proved not to be the case. When digging clay, the material enters into the bucket along the cutting edge of the lip, and is pushed along the inside surface of the lip and then to the inside of the hood. The inside flange of the new-type lip, being on the inside of the hood, provides an interruption which prevents the clay from coming into close contact with the hood as it passes the lip, and allows soft or loose material to lodge between the clay and the hood, which facilitates dumping, instead of retarding the material.

CASTING TEETH ON INSIDE OF LIPS

The inside-outside lip has opened the way for trying out an experiment of casting teeth on the inside of the lips, which, up to date, is working out satisfactorily. Some lips with the teeth cast on, as shown in Fig. 3 (4), are being tried out and have been in service about five months. Mr. Hopfield states that they show an improvement when digging clay and cemented gravel.

The inside-outside lip is patented and is manufactured by both the Columbia Steel Co., of San Francisco, and the Taylor-Wharton Iron & Steel Co., of High Bridge, N. J.

A return to the double-flanged lip is shown in Fig. 4 in a modified form. This is known as the improved Reiling lip, which was recently turned out by the American Manganese Steel Co. This has a complete riveting inside flange and an outside flange at the top portion of the bucket. It is easy to make a casting that will fit the bucket. Lips of this pattern are in use at Dayton, Nev., on the dredge of the Gold Canyon Dredging Co. The lip is flared in such a way as to take the side cutting wear upon the lip rather than upon the side portion of the hood. In the center portion of the lip, the rivets are in double shear.

Fig. 5 is a photograph of one of the Natomas boats digging hardpan with the ladder in a high position. It illustrates excellently the severe service given to bucket lips. The scraping action of the bucket lip of the first (1) bucket coming into action is particularly noticeable. The lower angle of incidence of the bucket (2), immediately preceding, shows how the excavated material is crowded into the bucket hood. The third (3) bucket, with the ladder in a lower position, would also be in a digging position. For the ladder in a lower position the relative position of the buckets would be approximately the same. The bucket lips shown are inside-outside lips.

Acknowledgment is made of the courtesy of Corey C. Brayton and L. D. Hopfield, both of whom contributed the illustrations for this article and discussed the development of the various designs with me.

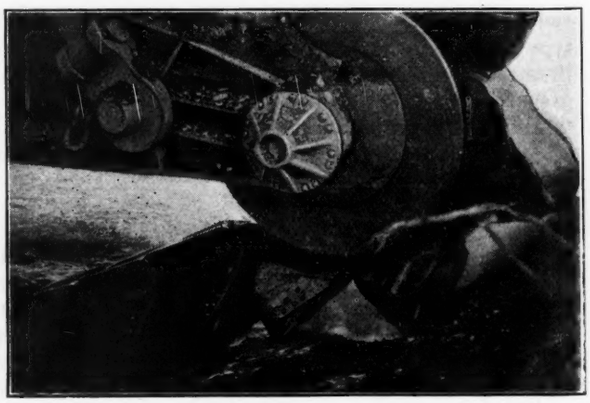


FIG. 5. DIGGING HARDPAN WITH LADDER IN HIGH POSITION

By The Way

A Thrill

Broadway engineers got a thrill the other day when "Her Salary Man," a comedy in three acts by Forrest Rutherford, made its first appearance at one of the local theaters. It fairly warmed the cockles of the heart, whatever they may be, to see how the engineer was able to snatch a few moments from his professional work to write a play that would prove acceptable. Some, no doubt, began to feel that perhaps they too would try their hand at this sort of thing. There was money and distinction in it. Feeling thus ourselves, we called Mr. Forest Rutherford up at his office at 120 Broadway to ask him to recommend a textbook on the subject. But our Mr. Rutherford said he has been getting quite a bit of credit for this other man's work for a long time. So we rang off disappointed.

Excelsior

Necessity is the mother of invention. The results of testing man's ingenuity abound, and by them we measure progress. Great strides are being made in the development of mining machinery, especially in devices designed to help in discovering new deposits of ore. It is to be noted as the year 1921 draws to a close, and it is reason for complimenting the designing engineers, that the pick and shovel and the diamond drill are gradually displacing the divining rod and witching stick for prospecting purposes. Success and the spectacle of others' success fire the imagination, and it leaps ahead to the time when those using the latter implements will be open to criticism for their conservative ideas.

A Hunting Story

Cap'n Dick was in a capricious mood as he watched the unloading of a truck load of powder. Skillfully the men lifted the boxes one by one and carried them into the magazine, where they were carefully shelved to await the time when they would be lowered in the "bal" for use underground. "'An'some chap, that there 'Ercules, isn't un," said Cap'n Dick, pointing to a picture of the mythical superhuman imprinted on the side of one of the boxes. "Who was he, Cap?" asked one of the men. "M'son," said Cap'n Dick, "'Ercules wuz a 'aughty 'unter 'oo 'unted 'ares in tha 'Ampshire 'ills, an' w'en 'e 'ad em 'e 'it em h'on tha 'ead with a 'eavy 'ammer an' they 'owled 'orribly. Dam-me, after that there I mus' be gettin' on. Don't forget to lock tha bloody door after thee."

Value Versus Profits

"We mine anything of value," the Creede General Mines Co., of Creede, Col., states on its letterhead. This is all right, so far as it goes: it makes employment for the unemployed, business for the supply companies, and tonnage for the railroads. But can they sell what they mine?

That is the question. Many things of value have long been more or less unsalable in the mining industry. Though conditions are improving, there are millions, hundreds of millions, of tons of low-grade ores that show value on the assay certificate but which would yield only a goose egg in net returns, or even a loss, if smelted or otherwise reduced. We are interested in this because we are working on a new process by which we hope to be able to treat practically anything and get 100 per cent recovery at a cost of practically nothing per ton. This is very promising. We shall be generous when we have this perfected and shall let all of our friends in on the ground floor.

Our Gold Threatened

A Londoner, H. Bond by name, claims he has discovered how to extract gold from mercury. Many an amalgamator knows how to do this, too, and therefore lets his finger nails grow long. Mr. Bond is an honest man we infer from the information given of him in the *Times* dispatch, and what he claims to do is to convert mercury at fifty-odd cents a pound into gold at $20.67 an ounce, which is certainly some conversion but not necessarily impossible. Once in a while Mr. Bond hurries too much or perhaps he works more carefully, with the result that he turns part of the mercury into radium instead of gold. But he can find abundant use for such impurities. The whole scheme, Mr. Bond says, is simply colossal, a Teutonicism surprising in the mouth of a Britisher. Some day, no doubt, the transmutation of the baser metals into gold will be an accomplished fact, and we frankly think it unwise to laugh too loudly at Mr. Bond until we have all the facts in the case. We are all the more on guard when we remember that 40 per cent of the world's gold is in this country. It would be just like some double-dashed furrin scientist to try something like this under the circumstances.

The Opal Superstition

The South Australian government last year appointed a commissioner to enquire in Europe as to the possibilities of securing a market for the white opal which is found in that state. Learning that on the Continent the old superstition that the opal is unlucky not only still lives, but is so strong that people will not buy the gem, the commissioner, Mr. Schlank, possibly remembering the axiom that a "rose by any other name would smell as sweet," thought that an opal by some other name might sell much better. He therefore suggested that this gem should be renamed. Dr. Herbert Smith, of the Kensington Museum, who was consulted, considered the idea a good one, and suggested as the new name the Greek word *irodos*, which being interpreted means rainbow. Several versions of the origin of the opal superstition have been given, and Mr. Schlank mentions one, which is probably the earliest, that dates back five hundred years—another instance of how hard some things die. It seems that in the long ago there were several large stage coaches running in France that were named after precious stones, such as ruby, sapphire, diamond, and opal. It so happened that the coach named "Opal" suffered numerous mishaps, and that several notables, including Napoleon in later years, who traveled by the unlucky vehicle, suffered grievous hurt. Mr. Schlank says that though the superstition is strongly prevalent on the Continent of Europe it does not greatly worry the more sophisticated American or Britisher.

Entirely Personal

George Graham Rice has turned up at Rocky Bar, Idaho, where he is reported to have interested New York capital in an option on a local property. The *Police Gazette* please copy.

CONSULTATION

Non-Metallics and Enameled Ware

"I understand that considerable quantities of non-metallic minerals are used in the manufacture of enameled ware, but I do not know exactly how they are used in that trade. Can you give me a little light?"

Many non-metallic minerals are used in the manufacture of enameled ware. The most important are sand, borax, feldspar, ground quartz, clay, soda ash, fluorspar, and whiting. In addition, the metallic pigments, zinc oxide and tin oxide, are essential in some processes. The enamel as applied to kitchen ware, bathtubs, jewelry, and other articles is a glass to which color is given by means of metallic oxides. The ordinary enameled kitchen utensils use a base of iron or steel for the coating; sinks and bathtubs, cast iron.

The enamel used in coating cast-iron sanitary ware is compounded of several of the various minerals mentioned above and is applied in two coats, a primary gray coat and a finishing coat of white. Manufacturers are careful to use an enamel that expands at the same rate as cast iron when heated; otherwise the enamel would crack and give an unsatisfactory product. The exact mixtures used depend largely upon the purity of the ingredients of the enamel, the metal used as a base, methods of manufacture, and much experimentation.

A mixture that has been successfully used as a ground coating by one manufacturer and reported by the U. S. Tariff Commission consisted of 44 lb. of sand, 18 lb. of borax, and 14 oz. of borax fused in a furnace. The molten mass is run into cold water and ground with an addition of 9 per cent by weight of quartz and 12 per cent by weight of clay. The enamel for this first coat, after grinding, is one-third part water and is called "soup." A skilled workman sprays this material over the article to be enameled, which is then heated in a high-temperature furnace to fuse the enamel and to make a smooth coat.

The finishing coat consists of a mixture of 37 lb. of feldspar, 31 lb. of borax, 31 lb. of sand, 24 lb. of soda ash, 9 lb. of fluorspar, 4 lb. 9 oz. of whiting, and 6 lb. of zinc oxide, which is mixed, fused, and ground with 14 per cent by weight of tin oxide, 7 per cent of zinc oxide, and 7 per cent of clay. The tin oxide is the most expensive ingredient of the enamel, and imparts the lustrous opaque white finish to the common enameled sanitary ware. The white coat is applied to the article to be enameled after it has been heated to a red heat.

Before the war Germany and Austria-Hungary were strong competitors of the United States in the manufacture of enameled ware, but the war eliminated this competition. Domestic production grew, and large quantities of enameled ware were exported to countries formerly relying upon Germany for their supplies.

The United States is in a splendid position as regards raw materials for this industry, practically all of them being produced in this country. At present the industry is feeling the drop in trade noted in other industries, but it is an important factor in the consumption of a great many non-metallic minerals.

The Use of Taper Ropes for Hoisting

"Will you kindly tell me whether round taper ropes are being used at the present time for hoisting purposes in mines in the United States and the world. Are they a recent development in the industry and how is their use generally regarded by mining engineers?"

So far as *Engineering and Mining Journal* is aware, no round taper wire ropes are being used at present for hoisting purposes in American mines. They have been used in South African gold mines, according to Peele's "Mining Engineers' Handbook," although no definite reference is given as to the mine employing them. Behr, in a paper entitled "Winding Plants for Great Depths," issued by the South African Institution of Engineers, states that round taper ropes were tried at some of the Comstock mines as early as 1875. One of the ropes was used to operate a 37 deg. incline 1,400 ft. long, through a shaft 1,400 ft. deep, from a hoist engine on the surface. The rope was in use from 1875 to 1884 and was 2 in. in diameter at the top and 1¾ in. at the lower end. The load at the end of the rope was ten to twelve tons. Behr states that considering the conditions under which this rope operated the use of a taper would not be warranted.

At the mines of Przibram, Austria, taper ropes were used in the 80's for mines with a vertical depth of 3,900 ft. They were built of crucible steel wire having an ultimate strength of 120,000 lb. and were made with a regular taper, starting from the small end. One wire was was cut about every 16 ft. and a larger one brazed on. Each rope consisted of seven strands around a hemp core, each strand consisting of six wires around a similar core. The initial factor of safety due to static load condition alone, and without considering the effect of bending, was about 7, and the ropes lasted from three to four years. Five shafts used the taper ropes, and two of them were over 4,000 ft. deep. Other examples of mines using taper ropes are the Ronchamp collieries, in France, and the Preussen shaft No. 2, in Westphalia.

Two varieties of taper ropes have been designed. In one, the same number of wires are used throughout its length, the taper being obtained by reducing the individual sizes of the wire; in the other form the taper is obtained by decreasing the number of strands.

Although taper ropes possess theoretical advantages, one of the objections to their use has been the necessity of designing the taper rope for each depth of mine, and that straight ropes can be had to hoist a reasonable load from a 5,000-ft. depth. It is worthy of note that in the new shaft of the City Deep mine, in the Transvaal, which is to be 7,000 ft. in vertical depth, a 2-in. flattened strand rope will be used. A flattened strand rope is essentially a round rope.

Behr contends that taper ropes are as reliable as those of uniform section and would cost less for deep shafts than ropes of uniform section and of equal effective strength; also that taper ropes made, as they should be, with a long lower portion of uniform section, had a greater margin of safety at the most dangerous section than ropes of uniform section with tail rope for the same factor of safety.

HANDY KNOWLEDGE

Neighborly Chats With the Foreman

Selecting Men

BY DUNCAN MACGREGOR

Written for *Engineering and Mining Journal*

You're wrong, Jim, about the employment manager. You just said that it would take away your control over the men. Well, maybe it does take away a certain kind of control. This hiring and firing idea is well enough in its way, but perhaps it has had its day. There's another kind of control which may be in the long run best for every one. If I were you, I would get in line with that employment manager and first find out what he is planning to do and give it a chance. You and the employment manager pulling together will be worth while to you both. He's going to take a share in the responsibility, and you are going to be able to give more direct attention to your men. You are still the man at the front, and you have to handle the men. You've still to get the work out and keep the men out of trouble. In that sense you have the same job, and it's a man's-size job. Using your gray matter will make it a pleasant job, too, and you will have your men with you.

You ask how to size up men. It strikes me, Jim, that you have more troubles than a lady suffragette. You've put a tough question up to me. There's a good many kinds of men, Jim. There are slouchy men and neat men, know-it-alls, Handy Andys and men who can do one thing well; men who are careful and conscientious; men that are careless and heedless of the safety of others; men that deliver the goods, and others that are disappointments; men who are loyal; men that are sweet and sour and men that are just plain agitators. You have men with good gray matter who use their eyes and ears and men who always get in a hole. You have green men who are pure gold and some that are just plain dubs; some that are clean and some that are of the smutty-story type. Jim, there are as many different kinds of men as keys on a grand piano.

I know you want to ask: How about machine men, timber men, shovelers, and the others? That's all right from one point of view, but from another angle you have got to look deeper than that. You've got to look at the real man and size him up, and then you'll know what really makes a good timber man or a good machine man. You've got to be a bit of a psychologist—that's what I think they call it. Then you have to parcel your jobs out in accordance with what you know intimately about them. Put a man who has lots of gray matter and can keep himself out of trouble on your difficult and dangerous jobs and put the other kind where they can't hurt themselves. Put your green men on your clean-up gang where they can get around and know the mine and you can get a line on them. Have one of your best men in charge of this gang and get him to tell you how the new men stack up. Then shove them along, first on shoveling and next as helpers on the timber gang, and then try them out on a machine. Make a study of each one until you can place him to his and the mine's advantage. Of course you can size up a man's hands and his feet and the way he handles himself, but these are superficial alongside of getting really acquainted. You can find the man for the job if you do it.

One additional thing you can tuck away and think about. Be sympathetic with your new man and let him know that you have faith in him. This belief in a man is a wonderful way to get a grip on him.

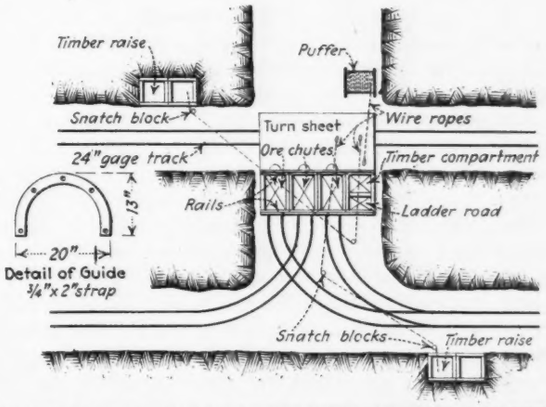
Handling Ore and Timber in Removing a Shaft Pillar

BY BYRON G. BEST

Written for *Engineering and Mining Journal*

Some years ago, in removing the pillar which had been left around an abandoned shaft in one of the Michigan iron mines, the following method of handling ore and timber was used:

The block of ore to be recovered was about 75 ft. high and lay on a dike about 80 ft. above the highest operating level and 1,000 ft. from the operating shaft.



LAYOUT OF STATION ON NEW LEVEL OPENED AT BOTTOM OF OREBODY, 80 FT. ABOVE OPERATING LEVEL

To remove the pillar with a minimum amount of rock work, a drift on the existing level was extended to the old shaft. Between the level and the bottom of the ore the old shaft timber was removed and replaced with cribbing, converting the shaft into a five-compartment raise, this including three ore chutes, one timber compartment, and one ladderway.

A new level was opened at the top of the raise, and raises were put up and sublevels opened for the removal of ore. To furnish an additional outlet in the case of accident, a second raise was put up, connecting the two levels. The old shaft, however, was used in hoisting all of the timber and in transferring most of the ore to the lower level.

The timber compartment was lined with plank, and an air hoist, or puffer, was installed at the top of the raise, as shown in the accompanying sketch. Timber was hoisted to the top of the raise by the puffer, and carried by hand to one of the two timber raises leading to the sublevels and situated on opposite sides of the shaft. Each of these raises was equipped with a wire rope running over a sheave wheel at the top of the raise and around two snatch blocks on the level, where

either rope could be connected to the rope on the drum and the timber hoisted to the sublevels by the puffer. The ropes were connected by passing a small clevis through loops in the end of each rope.

The ore was trammed to the transfer raise in one-ton, end-dump cars. On the south side of the raise the ore from the east side of the pillar could be dumped into either of two compartments, and the ore from the west side into only one compartment. The tracks ran to the edge of the raise, where a rail laid across the tracks stopped the cars and made dumping easier. On the north side of the raise a turn-sheet was installed, and ore from any part of the pillar could be dumped in any compartment.

At the center of each ore compartment a semicircular guide of ¾ x 2-in. strap iron was fastened to the turn-sheet. The outside width of the guide at the open end was 1 ft. 8 in., a little less than the distance between the inside faces of the wheels. The guides brought the cars in the proper position for dumping, and a rail similar to the one on the opposite side of the raise stopped the cars and assisted in dumping.

Spillage and Dust Losses

BY GEORGE J. YOUNG

Written for *Engineering and Mining Journal*

So far as is known no comprehensive study of spillage and dust losses in handling ores in metal mining has been made. It is undoubtedly negligible in many instances, but often it must amount to an appreciable item in a year's time, particularly where high- and medium-grade ores are handled. Spillage losses take place at ore chutes due to careless loading or inefficient gates. Overabundant loading results in top spillage. Chute and top spillage can be retrieved in part. Bottom spillage which takes place by fine dust sifting through holes in the bottom of cars, trucks, or wagons or through the cracks and openings about the doors or gates is seldom retrieved. By the use of tight bottoms and a type of car which can be dumped by the revolving tipple, bottom spillage can be reduced to a minimum. A special design of auto-truck gate that is tight is feasible, although no special attempt appears to be made to supply trucks equipped with such gates.

Dust losses on conveyor belts are due to fines and sticky material adhering to the belt and deposited by it upon the conveyor framing and floor. These losses are sometimes retrieved in part by regularly cleaning up, but as tight floors are not often conspicuous a certain loss is undoubtedly permanent. In one instance a mining company installed a bristle brush on the under side of the conveyor head pulley and retrieved some of the loss. The discharge of the brush was received in a small bin. Undoubtedly a thorough working out of the design of a cleaning brush would prove to be advantageous.

Dust losses due to wind are undoubtedly large at certain periods or seasons and when ore cars or trucks are unprotected. With ore piles exposed to winds there are undoubtedly heavy losses where much fine ore is present and it is dumped upon the ore piles from any height. At one large smelter the ore beds are protected by a tight fence surrounding the ore piles. This is an excellent safeguard. Windage protection should be provided in the design of all ore-handling plants, particularly in those where it is customary to treat fine dry ores.

At a small concentrating plant in which gold and silver ores were handled an attempt was made at drying the concentrates in a small yard contiguous to the plant, but the windage loss was so conspicuous that a drying furnace was installed in the mill and further loss thus prevented.

Another loss analogous to spillage losses is encountered in wet stopes. Excessive water flow carries off fines. These may be trapped in sumps and later retrieved, or they may be allowed to go to waste as is often the case.

It is evident that a careful survey of spillage, windage, and flowage losses is essential in every mining operation and particularly in long-continued operations where relatively large tonnages are handled. In the aggregate they may be worth preventing, though the cost may sometimes be in excess of the value of the material that is saved.

A Safety Device for Hoisting

Written for *Engineering and Mining Journal*

One of the simplest ways to prevent overwinding in hoisting is by the use of beveled guides just below the sheave wheel. If the ordinary guides in use are 4 x 6 in., the safety guide is made from a 6 x 8-in. timber. The lower end of the guide is framed 4 x 6 in. and made to connect with the standard guide. The guide is then gradually tapered to a size 6 x 8 in. at the upper end. Two of these guides of equal length are put in. The 6 x 8-in. end is just below the sheave wheel. The length of the beveled guide depends upon the head room available above the cage.

In case of overwinding either of two things usually happens. The cage is generally drawn up into the sheave wheel with such violence that the wheel is often broken, but sometimes, if the speed is sufficiently great when the cage strikes the sheave wheel, the rope is broken, and if the safety dogs refuse to hold the cage it drops back into the shaft.

When safety guides are used it is practically impossible to draw the cage up into the sheave wheel, and if the rope should break, the cage is held so tightly in these guides that it cannot fall back into the shaft. These guides hold the cage in two ways. They spread the shoes and they bind against the cage. The pressure exerted against the hoist is sufficiently great to bring it to a stop.

Safety guides of this type have been used for many years in the Southwest, most extensively at Cananea, and have proved to be very satisfactory. It has been found when there has been an overwind that the cage is caught so tightly in them that it is quite a job to get it out.

This type of overwinding device is simple, efficient, inexpensive and when properly installed requires no care or watching. It is not as satisfactory for high-speed, high-powered hoists as for the more common type of hoist. Its use is not nearly as general as it should be. Where used it has given great satisfaction, and it is no longer an experiment. The hoisting engineer always has the knowledge that the beveled guides are going to stop the advance of the cage into the sheave wheel. The worst that can happen is for him to run the cage up into the guides and get it stuck there, but he need have no fear of being the cause of a serious or fatal accident from overwinding if these guides are properly installed.

THE PETROLEUM INDUSTRY

The Djambi Oil Field of Sumatra

BY ARTHUR H. REDFIELD*

Written for *Engineering and Mining Journal*

CONSIDERABLE INTEREST has been aroused in recent months over the disposition of the Djambi oil field of Sumatra, Dutch East Indies. The subject has been the occasion for extended diplomatic correspondence between the governments of the United States and The Netherlands, and has attracted widespread attention in the daily press, as well as in the journals devoted to the oil and gas industry. In view of the comparative dearth in the United States of published data on the geology, occurrence, and character of the Djambi oil, a résumé is given in this paper of the known facts of the petroleum geology of Djambi.

The geology of the Djambi oil field is a part of the geology of Sumatra as a whole, and cannot well be made a subject of unrelated study. The Residency of Djambi, extending as it does nearly across the island, represents almost a complete topographic and geologic cross section of Sumatra. The oil-bearing strata of Djambi are intimately related to those of the producing oil fields of Palembang. The structure of the Djambi oil field is due to the same tectonic forces which produced the anticlines of Atjeh, Perlak, and Palembang, in Sumatra, and even of Java and Borneo. A brief discussion of the stratigraphic and structural geology of Sumatra is accordingly given as an introduction to the geology of the Djambi field.

MAP OF SUMATRA

A cordillera, the Barisan Highland, extends lengthwise through Sumatra from northwest to southeast parallel to the west coast and separated from it by a narrow coastal plain which nowhere exceeds nineteen miles in width. The Barisan Highland consists of parallel ranges, separated by upland valleys, which broaden in places to plains and which elsewhere are broken by volcanic peaks. On the east slope of the cordillera spurs of the mountain chain extend toward the coast, especially in the northern end of the island, and in places broaden to plateaus. The western slopes of the cordillera descend steeply to the narrow coastal plain which borders the Indian Ocean; and consequently the watercourses of the western slope are comparatively short.

On the eastern side of the cordillera the foothills of the Barisan Highland are succeeded by a broad, flat plain, which is crossed by innumerable streams and rivers, sprinkled with numberless lakes, great and small. The level of the plain is broken by many hills largely of igneous origin, known by the Malay name of *boekit*.[1]

CRYSTALLINE ROCKS OUTCROP FREQUENTLY

The oldest rocks in Sumatra are gneisses, schists, and quartzites of indeterminable age. The origin may be referred in part to the pre-Cambrian and in part to the early Paleozoic. They probably belong to several geologic periods, but all were folded and denuded before the Permo-Carboniferous beds were deposited. These crystalline rocks form the backbone of the island, and crop out at numerous places in the Barisan Highland. They are penetrated here and there by pre-Carboniferous intrusions of granite.

The oldest sediments in Sumatra that can be determined by fossils are Permian (or Permo-Carboniferous?). Limestones of Permian (or Permo-Carboniferous?) age occur in several zones extending lengthwise through the Barisan Highland and in the Goemai Mountains, which form the easternmost range of the Barisan Highland in southern Palembang.

For years it was supposed that Mesozoic formations were lacking in Sumatra. However, fossils of Upper Triassic age have been found in the upper basin in Kwaloe River, in East Sumatra, and of Jurassic and Cretaceous age in isolated areas in the mountains of Upper Djambi. The "old slates" (*oude leien*), which crop out in zones throughout the Barisan Highland and surround Tigapoeloe and Doeablas Mountains, are considered by Tobler to be Jurassic.

The Tertiary oil-bearing system of Sumatra is of principal interest in this discussion. Tertiary deposits are widely spread over the plains and low-lying country of Sumatra. The lowlands of the east coast, which attain a breadth of 130 miles in Palembang, are underlain beneath the Quaternary surface deposits by Tertiary sediments, which are cut in places by volcanic intrusions. The coastal plain of the west coast, nineteen miles wide near Benkoelen, is also composed chiefly of Tertiary sediments.

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[1]Pronounced "bookit." The Dutch orthography has been followed in this paper in spelling Malay words and place-names.

Igneous rocks are found in their greatest development in the Barisan Highland, where eruptives form a broad zone twenty to thirty miles wide in places. Intrusions of igneous rocks in the Tertiary lowlands to the northeast of the mountains form hills or *boekit*.

Structure of Petroleum Areas

The petroleum fields of Atjeh, Perlak, Djambi, and Palembang all form subordinate basins of a great geosyncline, which may be traced from Burma throughout the length of Sumatra as far as eastern Java. This geosyncline is bounded on the west by the Outer Malay Geanticlinal Arc, which extends from the Arakan Yoma Range of Burma through the Andaman and Nicobar Islands, the Barisan cordillera of Sumatra to the crystalline massifs of Tji-Letoe, Lohoeloh, and Diivo on Java, and on the east by the Inner Malay Geanticlinal Arc, which extends from the East Burman ranges through the Malay peninsula, the islands of Banka and Billiton to the Karimoen-Djawa Islands, lying north of Java. From Burma to southern Sumatra the tectonic lines bear generally north - northwest — s o u t h-southeast. At the Strait of Sunda, the tectonic lines turn sharply in an east-west direction. The geosyncline is filled with folded Tertiary strata. The bearing of the axes of folding is parallel to those of the inclosing geanticlines.

The existence of the Outer Malay Geanticlinal Arc is evidenced in the southwestern or mountainous half of Sumatra by a series of pre-Tertiary *coulisses* due to folding. By *coulisse* is meant one of a series of ridges *en échelon* on the earth's surface, like the wings (French, *coulisse*) of the stage in a theatre. Such features are formed by folding of the stratified rocks and the intrusion of masses of igneous rocks, followed by erosion. The S u m a t r a *coulisses* are a p p a r e n t l y part of a system of *écheloned* ridges that may be traced up the Malay Peninsula to the central highland of Asia, and that continue to the east and northeast through many of the other islands comprising the Dutch East Indies.

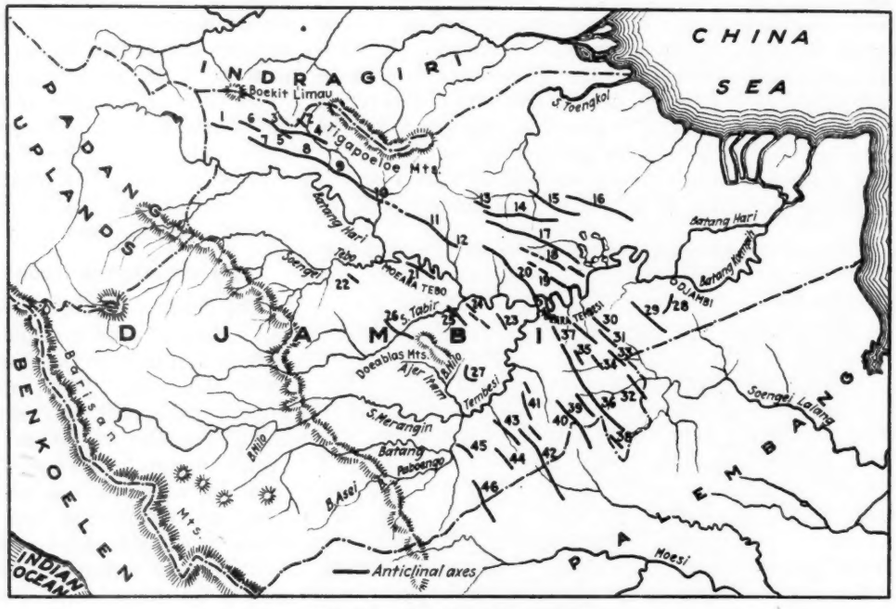
The West Sumatra *coulisse* extends with many interruptions from the extreme point of Atjeh lengthwise through the island to Cape Bata, in the District of Lampong. Numerous parts of this *coulisse* are still unknown or hidden from the eye by Tertiary and later volcanic deposits. A series of longitudinal valleys separates the West Sumatra *coulisse* from a series of eight eastern *coulisses*. These structures are of varying length, but follow a trend generally parallel to that of the West Sumatra *coulisse*. They reach their greatest width in the highlands of western Djambi and the Padang uplands.

Van Es suggests the existence of an outlying *coulisse* extending from Cape Perbaben to the Strait of Banka. The existence of this *coulisse* in the south of the Island of Banka has been demonstrated.

Tertiary anticlines paralleling for the most part the trend of the main tectonic lines of the island abound in the geosynclinal basins of the east coast of Sumatra. They are particularly numerous in central Palembang and Djambi, as well as in eastern Atjeh. The geology of central Sumatra is not sufficiently well worked out to permit statements as to the tectonic phenomena of its eastern lowland.

Three sets of lines of volcanic activity occur—longitudinal, transverse, and oblique. These series of volcanic lines are confined to the southwestern or mountainous portion of Sumatra. The longitudinal lines trend northwest to southeast, parallel to the main tectonic lines of the island. The transverse lines are normal to the longitudinal lines. Diagonal lines, bearing roughly north and south, occur in a few places.

A number of fault lines also have been observed in Sumatra. These lines have the same direction as have been noted in the volcanic lines, longitudinal, transverse, and diagonal. Faulting is confined, with one noteworthy exception, to the southwestern or mountainous half of the island. The exception is a fault traced by Van Es



MAP OF DJAMBI OIL FIELD

Key to Anticlines of Djambi Field. (Roman numerals after name indicate the "order" of the anticline)

1. Pemerian (III)
2. Sentano (IV)
3. Tjimpegan (III)
4. Gloempang Besar (III)
5. Soeroet (II)
6. Djenking (III)
7. Karang (II, III)
8. Oeloe Inoem (III)
9. Melawah (II)
10. Soemai (III)
11. Rengas-Kilis (III)
12. Loeboek Kepajang (III)
13. Loeboek Lesoeng (IV)
14. Soeban Trang Djilan (III)
15. Pematang Lantih (IV, III)
16. Toeba Obi (III)
17. Benana-Singoan (III)
18. Sangkilan (III)
19. Kahidoerian (III)
20. Singkati-Sanggalan (III)
21. Serian-Selangli (II)
22. Aboeran-Koempih (II)
23. Mersam (II)
24. Geger (III)
25. Inoem-Bandoeng (III)
26. Rantau-Limau-Manis (III, IV)
27. Batang Nilo (IV)
28. Kenali-Assam (III)
29. Kempino (III)
30. Kehilangan-Badjoebang (II)
31. Rambei-Betoeng-Sembio (III)
32. Boeajan-Boeloeh (III)
33. Pajo Ngalega-Temidai-Mengkanding (III)
34. Meroeo-Senami (III)
35. Iboel (III)
36. Pendjarokan-Soengei Boengin-Moeara Badak (III)
37. Djangga (III)
38. Kapas Oost (III)
39. Ketidoeran-Boetang (III)
40. Ketalo-Manggoel (III)
41. Tanah Abang-Pemoesiran (III)
42. Telisa (IV)
43. Sekamis (III)
44. Plajang Semoet-Djelait (III)
45. Ajer-Meroewap (II)
46. Djelapang (III)

across the east coast of Sumatra from the mouth of River Rokan to Lucipara Point.

A fault with a marked overthrust is believed by Van Es to run from Koeta Radja to Atjeh to Semangka Bay, in Lampong. The existence of this fault, as of other faults in the same area, is difficult to establish because of the thick flows of eruptive rocks.

Petroleum Geology of Djambi

The topography of the Residency of Djambi is characteristic of both the Sumatran cordillera and the east coast lowlands. From the sea and from the Tigapoeloe Mountains, which constitute an outlier of the Barisan Highland, a relatively flat plain extends over three-fourths of the area of the residency, its surface broken only between Tabir and Merangin rivers by the Doeablas Mountains, which are a smaller outlier of the Barisan Highland. Toward the southwest the plain rises to meet the foothills of the Barisan Highland, which occupies the remaining portion of the residency.

The Tigapoeloe Mountains consist of an intruded massif of pre-Carboniferous granite, about which a belt of the "old slates" (Jurassic?) crop out. The Doeablas Mountains are a similar structure.

The plain of central Djambi consists chiefly of Tertiary sediments. Tertiary rocks ranging from the Eocene to the Pliocene are exposed in strips due to the folding of the strata throughout southeast Djambi and around the Tigapoeloe and Doeablas Mountains. To the northeast and southeast the Tertiary beds dip under the Quaternary and Recent alluvial deposits.

The mountains of Djambi begin on the northeast with a granite massif, and are succeeded by a zone of Permian or Permo-Carboniferous (?) rocks and a zone of the "old slates" (Jurassic?). The Barisan Mountains proper, which form the boundary between the residencies of Djambi and Benkoelen, consist of late Tertiary and Quaternary eruptives.

Cretaceous fossils have been found in Upper Djambi in isolated areas on the left bank of Batang[2] Asei and near Tapoeatan.

Oldest Sedimentaries Principally Limestones

The oldest sediments that can be determined by fossils, in Djambi as in Sumatra, are Permian (or Permo-Carboniferous?). These consist prevailingly of massive limestones. Associated with the Permian or Permo-Carboniferous limestones in Djambi are shales, sandstones, conglomerates, graywackes, diabase—and porphyrite—tuffs, and marls. Unconformably overlying the Permian are the "old slates," ascribed by Tobler to the Jurassic. These consist of slates, quartzites, phyllites, and conglomeratic graywackes. The isolated occurrences of the Cretaceous which occur in Djambi consist of limestone and of shales with intercalated limestone beds.

The Eocene of southern and central Sumatra is represented by a lower or "breccia stage" of conglomerates, breccias, sandstones and marly shales, and by an upper or "sandstone stage" of shales, clays, and coal-bearing sandstones. The lowest member of the Tertiary, however, which appears in the Residency of Djambi is the "basal conglomerate" (Eocene?), which occurs in isolated outcrops surrounding Tigapoeloe and Doeablas Mountains.

The Telisa beds, which in central Djambi overlie the "basal conglomerate" unconformably, form the equivalent of the Goemai beds (Lower Miocene) of Palembang. Their thickness is estimated at about 3,280 ft. The Telisa beds consist of well-bedded, hard, generally chocolate-brown and gray shales and clays, in places containing typical concretions. Locally beds of limestone occur. The shales are sufficiently compact to form in places steep perpendicular cliffs.

The Telisa beds are conformably overlain by the Lower Palembang beds (Upper Miocene). These are purely marine in origin, and consist of more or less well-bedded green-blue clays and sandstones, and less important beds of sandy shale. Coralline and glauconitic limestones crop out in only one or two places. There are few lignite beds. Tuffaceous sediments also occur. In Djambi the Lower Palembang consists of about 6,600 ft. of more or less well-bedded greenish-blue marine clays and sandstones, as well as sandy shales. The Lower Palembang beds, it may be remarked in passing, contain the principal petroleum horizons of North Sumatra.

Middle Palembang Contain Principal Oil Horizons

The Middle Palembang stage (Lower Pliocene) contains the principal oil horizons of the Residency of Palembang. A typical development of this stage is found in the Kampong Minjak and Minjak Itam oil fields, east of Moeara Enim, in Palembang. Its lowest member consists of lignite measures about 130 ft. thick. The "lower clays," which overlie the lignites, consist of about 295 ft. of sandy and pure shaly clays, and are overlain by shaly sandstones 410 ft. thick. The "upper lignite measures," which form the highest member of the stage, total about 410 ft. in thickness.

The Middle Palembang beds evidently do not attain the thickness in Djambi that they do in Palembang. In Djambi they vary in thickness between 400 and 2,000 ft., and consist chiefly of sandy clay-shale, without marine fossils. Only a few interbedded lignite seams occur, none of which exceed 10 ft. in thickness.

The Upper Palembang stage (Upper Pliocene) consists of tuffs which vary from white and gray to azure blue, but whose color above the ground-water level, however, is in most cases pink to red. A few isolated lignite seams occur locally. The lower part of the Upper Palembang stage shows distinct stratification; this is not the case, however, with the upper beds, which are difficult to distinguish in many places from the overlying Quaternary tuffs.

The Upper Palembang beds (Upper Pliocene) consist of azure-blue soapy tuffs, which weather to a grayish yellow. They are with difficulty distinguished from the overlying Quaternary tuffs, which may indeed be a denudation product of the Upper Palembang beds. The thickness of the Upper Palembang stage exceeds 2,000 ft.

Quaternary deposits of lateritic clays and more or less sandy tuffs occur in horizontal beds in the upper valleys of Batang Hari and Batang Tembesi. Alluvial terraces of unlateritic clay occur also in these valleys.

Granite massifs form a considerable part of the Barisan Highlands. Late Mesozoic granites constitute the cores of Tigapoeloe and Doeablas Mountains in Djambi.

Diabasic rocks form numerous small dikes in the granite massifs of the Barisan Highland and in the massif of Oeloe Rawas. Porphyries and keratophyres occur in the mountains, as well as at places on Tembesi River.

Andesites, diorites, gabbros, augitic porphyries, am-

[2] "Batang" in Malay means "river."

phibole porphyrites, and other igneous rocks, chiefly basic, are found in the *boekits* that project from the plain.

The petroleum fields of Djambi lie within the Upper Tertiary peneplain province of South Sumatra. This extends from Tigapoeloe Mountains as far as the southeastern portion of the Residency of Palembang, where the peneplain disappears under the relatively horizontal layers of Quaternary tuffs. It cuts across Tertiary sediments, folded into a series of elongated anticlines and synclines.

In the southwest the oil fields of Djambi border upon the Sub-Barisan Plain, a relatively narrow strip of unfolded late Tertiary tuffs, which separate the Barisan Highland. To the northeast the petroleum fields border on the extensive, low and geologically unexplored coastal marshes.

The anticlines of South Sumatra have been classified by Tobler as anticlines of the first, second, third, fourth, or fifth order, according as the Upper or Lower Pliocene, Upper or Lower Miocene, or older formations have been exposed by erosion on their domes.

A continuous anticline, designated by three or four names of subordinate parts, lies to the north of Batang Hari and extends in a general northwest-southeast direction. The dips of the limbs of the anticline vary in places from 20 to 30 deg. Both Lower Palembang and Middle Palembang beds are exposed on its crest.

A group of minor anticlines, roughly parallel to the main anticline, occur in northwest Djambi between Batang Hari and Tigapoeloe Mountains. These are chiefly of the third order.

East of the Tigapoeloe Mountains several important anticlines, chiefly of the third order, begin, and continue southeastward to Batang Hari.

West and northwest of Soengei[3] Tebo the Tertiary strata between Batang Hari and the mountains are relatively flat-lying. A small anticline of the second order occurs south of Soengei Tebo. A long anticline of the third and fourth orders, whose major axis bears northwest-southeast, crosses Soengei Tabir, extending to Doeablas Mountains, and a small, somewhat curved anticline of the fourth order occurs to the east of the mountains.

A series of short anticlines of the second and third orders, whose major axes have the general northwest-southeast trend, occur for a limited distance south of Batang Hari and west of Batang Tembesi.

The portion of the Residency of Djambi lying south of Batang Hari and south and east of Batang Tembesi contains no less than nineteen anticlines, of which the majority are of the third order. The major axes of the anticlines trend generally northwest-southeast. The most intensive folding occurs in the southwest part of the anticlinal group.

The presence of petroleum in the Tertiary formations of Djambi is suggested by numerous seepages of oil, with or without natural gas, as well as emanations of methane, carbon dioxide, and hydrogen sulphide. Salt springs, known by the Malay name of *soeban*, also occur. These indications occur for the most part on the flanks of the recognized anticlines.

Possibilities of Petroleum in Central Djambi

The possibilities of obtaining petroleum in commercial quantities from central Djambi, such as may be forecast on the basis of the known geology, are decidedly good. The strata show numerous indications of petroleum in the form of active seepage. The anticlines and synclines of the Palembang peneplain are continued in Djambi, and probably indeed on the other side of Boekit Limau through Indragiri, Siak, and the northern east coast to Atjeh, where the existence of a folded structure has been established. The geology of central Sumatra has not been sufficiently worked out, however, to affirm this positively.

From all appearances, however, petroleum will be found in Djambi at different geologic horizons than in Palembang. The Middle Palembang stage, which contains the principal oil horizons of Palembang, does not attain the thickness in Djambi that it has in Palembang. Moreover, sandy shales are the predominating formation in Djambi, with fewer and thinner lignite seams. Oil and gas seepages are almost entirely absent from the outcrops of the Middle Palembang of Djambi.

However, the Lower Palembang stage, which comprises the productive oil horizons of Atjeh, is well represented in Djambi. It contains, moreover, a proper succession of porous and impervious beds, suitable for the accumulation of commercial deposits of petroleum. It is significant that by far the great majority of the oil seeps, gas emanations, and *soebans* in Djambi occur in outcrops of the Lower Palembang beds. A few issue from the Telisa beds, and few or none from the Middle Palembang.

Occurrence Resembles That of Neighboring Fields

The occurrence of petroleum in Djambi in the Lower Palembang stage is in accordance with experience in the neighboring fields. In Palembang the oil-bearing horizons have been found in progressively lower geologic levels in a line from southeast to northwest. At Moeara Enim oil is obtained from the Middle Palembang stage (Lower Pliocene). On the Soeban Boeroeng anticline, to the northwest, oil was struck at a depth corresponding to either the lower beds of the Middle Palembang or the upper strata of the Lower Palembang (Upper Miocene). On the Manggoel anticline, in northwestern Palembang, which is a continuation of the Ketalo-Manggoel anticline of southeastern Djambi, a gusher was struck in the Lower Palembang strata. Gas emanations and an oil seepage on the flanks of the Pendjarokan - Boengin - Badak anticline of southeast Djambi, the outcrops of an oily clay on the north flank of the Rantau-Limau-Manis anticline of central Djambi, are both referred to the Lower Palembang stage.

The progressive descent to lower geologic levels in the occurrence of the oil along a southeast-northwest line has been attributed by Hövig[4] to the conditions under which the sediments were originally laid down. The synclinal basin of central Djambi and Palembang was occupied in Upper Tertiary times, according to this author, by a marine gulf, whose major axis extended northwest-southeast, in which the strata of that epoch were successively deposited. Frequent secondary oscillations of level, alternate elevations and subsidences, caused this body of water to alternate between a swamp in which lignite beds were formed and a deep-sea gulf in which rocks barren of organic matter were deposited.

At the successive climaxes of elevation, a "drift zone" would be constituted in the shallow waters under the northwest head of the gulf, in which the organic remains which Hövig assumes to have constituted the basis of the oil would accumulate. The gradual filling

[3] "Soengei" in Malay means "stream."

[4] See reference in appended bibliography.

of the gulf by sedimentation would cause the "drift zones" of later geologic stages created by the successive alternations of elevation and subsidence to migrate in geographic position constantly toward the southeast. Accordingly, the oil-bearing strata derived from these "drift zones" would be found at successively higher geologic levels to the southeast and at successively lower geologic levels to the northwest.

Analyses of oil from seepages in the Djambi field have not so far been published, and there has been no drilling. Analyses are available, however, of the oils of the adjacent Palembang fields. These show, in general, a series of asphalt-base oils, dark brown, red-brown, or greenish gray in color, and rich in gasoline and in kerosene. The specific gravities of the Moeara Enim oil range from 0.835 (37.6 deg. Bé.) to 0.875 (30 deg. Bé.) at 15 deg. C. The percentage of gasoline of the Palembang oils has been known to reach as high as 70; the majority of the analyses, however, show a percentage of light oils ranging between 40 and 60. The average kerosene content varies between 40 and 30 per cent.

To what extent these analyses of Palembang oils are of value in determining the characteristics of the oil to be obtained from the Djambi fields is open to question. The evidence would appear to show that the oil-bearing formations of Djambi belong to the Lower Palembang stage of the Miocene, whereas those of Palembang occur in the Middle Palembang stage.

Few analyses of the Pliocene and Miocene lignites of Djambi and Palembang are available. The lignites of the Middle Palembang (Lower Pliocene) strata of Moeara Enim show a water content of 23 to 25 per cent. The percentage of water in the Lower Palembang (Upper Miocene) lignites of Djambi is not known; the Miocene lignites of Benkoelen, however, contain 14 to 20 per cent of moisture. The Eocene coals of Tapan, in the lowlands of Padang, show 5.3 per cent water.

David White[5] has shown in the Appalachian oil fields of the United States a fixed relation between the degree of carbonization of coals and the quality of the associated mineral oils. Jezler's[6] study of the water content of the lignites in the Sanga Sanga oil field of Borneo indicates a similar relation between the grade of the oil and the moisture content of the associated lignites. On the basis of the known data regarding the lignites of Sumatra, it may not be amiss to assume that the oils of Djambi field will show an even lower specific gravity and an even higher content of light oils than the average of the Palembang oils. No analyses, however, have been published which would substantiate or disprove this assumption.

The right to exploit the oil fields of the Residency of Djambi is vested by a bill recently passed by the States-General of The Netherlands in the Nederlandsche Indische Aardolie Maatschappij (Netherlands India Mineral Oil Co.). Its capital is 10,000,000 guilders ($4,020,000), half of which is supplied by the Dutch East Indian government and half by the Bataafsche Petroleum Maatschappij (Batavia Petroleum Co.), a subsidiary of the Royal Dutch-Shell group. The control of the Netherlands India Mineral Oil Co. rests in a board of five members, three of whom are nominated by the Dutch Colonial Office.

A petition for participation in the Djambi field was presented to the First Chamber of the States-General by the N. V. Nederlandsche Koloniale Petroleum Maatschappij (Netherlands Colonial Petroleum Co.), of Rotterdam, a subsidiary of the Standard Oil Co. of New Jersey.

The bill vesting the rights of exploration and exploitation of the Djambi fields in the Netherlands India Mineral Oil Co. passed the Second Chamber of the States-General in April, 1921. This proposed grant has been the subject of negotiations between the governments of the United States and of The Netherlands. The subsequent passage of the bill by the First Chamber and the royal approval have since made the bill a law.

[5]White, David, "Some Relations in Origin Between Coal and Petroleum." Journal of the Washington Academy of Science, Vol. 5, pp. 189-212. Washington, 1915.

[6]See bibliography.

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ECHOES FROM THE FRATERNITY

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Bureau of Mines Seeks Improved Methods For Mineral Industries

Director Bain's Report Covers Various Activities Including Studies in Metallurgy, in Ore Recovery, Explosives, Oil Production and Refining, and Helium

IN HIS ANNUAL REPORT just made to the Secretary of the Interior, H. Foster Bain, director of the U. S. Bureau of Mines, states that the investigations conducted by the Bureau in the course of a special effort to aid the mineral industries to reestablish themselves on a safe business basis to meet the renewed foreign competition and the changed conditions of supply and demand of the post-war period point the way to the possible saving of vast sums through the application of improved methods in the production of various mineral materials.

METALLURGY OF ZINC TO BE INVESTIGATED

The cost of production of zinc, with the standard retort process, is now so high that it endangers the position of zinc as a cheap metal. Plans have been formulated for an investigation of proposed methods for the electrothermic metallurgy of zinc, with a view to increasing the recovery of the metal and lowering production costs. The results of an investigation regarding the losses of fines in the tailings of zinc metals in the Wisconsin district indicate that the use of concentrating tables of a certain type will greatly increase recovery. It is estimated that this practice would have added about $1,000,000 annually to the value of zinc output in this district had it been in operation in 1917.

Important results in the utilization of the low-grade and complex ores of copper, lead, silver, and zinc, which constitute a great problem in the mineral development of Utah, Colorado and other Rocky Mountain states, are promised by the utilization of the chloride volatilization process. The sulphur dioxide leaching of porphyry copper ores of Arizona holds the promise of important developments for the mineral industry of the Southwest.

STUDY OF LOW-GRADE IRON ORES

The Bureau investigated the properties and possibilities of molybdenum, of which the United States possesses the largest known deposits, although the country is relatively poor in high-grade deposits of some other important alloying elements used in alloy structural steels, such as automobile steels. The Bureau conducted studies directed toward devising means for utilizing extensive deposits of low-grade iron ores that cannot be smelted profitably by present methods. These studies included investigations of the low-grade iron ores of the Birmingham, Ala., district, the manganiferous iron ores of the Lake Superior district, and the iron and steel situation in the Pacific Coast states.

An investigation of scrap losses in aluminum-alloy foundry practice showed that the annual losses in the United States amount to $1,200,000 and that universal adoption of methods recommended by the Bureau of Mines would probably result in a saving of about $600,000 per annum. Melting losses in this industry, which are largely preventable, aggregate about $3,000,000 yearly. A new method was devised to simplify the collection of radium emanation from radium salts. Experiments are now in progress to perfect the process and to develop apparatus that can be recommended for public use in laboratories and hospitals.

About one-quarter of the bituminous coal produced in the United States is used in industrial power plants, and the waste of unburned coal and coke in the ashes from boiler plants has been investigated by the Bureau. It has been possible to recover the greater part of the unburned fuel by washing the ashes on a concentrating table. As the result of a study of coal washing problems in the State of Washington, one mine has built a table washing plant to treat a pile of refuse amounting to more than one million tons, estimated to contain 200,000 tons of recoverable coal of coking quality.

EXPLOSIVES INVESTIGATED

The Bureau also conducted studies regarding the use of liquid oxygen as an explosive. In co-operation with the Department of Agriculture an investigation was made of the use of cellulose from corncobs in the manufacture of dynamite. Investigations were conducted to determine the best and safest conditions for the industrial use of 13,000,000 lb. of picric acid, held as a surplus by the War Department. During the year the Bureau called attention to the danger in using certain low-grade foreign detonators, which had been coming into the country in large numbers.

A universal gas mask has been developed by the Bureau for protecting the wearer against all poisonous gas not exceeding 2 or 3 per cent concentration in air where a safety lamp will burn. A fireman's gas mask has also been developed. A small gas mask for the use of train crews in railroad tunnels was devised. Investigations made in connection with the problem of ventilation of vehicular tunnels showed that from 20 to 30 per cent of the heat of the gasoline used as fuel for automobile engines is lost in the form of unburned gases in the exhaust, due to improper carburetor setting.

Investigations at the Ceramic Experiment Station at Columbus, Ohio, indicate that some American clays will yield products closely approaching the English china clay. At the same station it has been demonstrated that better graphite crucibles can be made with the use of domestic bonding clay than have hitherto been made with imported clays.

PIPE-LINE AND OTHER OIL LOSSES

An investigation of losses of crude oil through evaporation in storage and in transportation, conducted during the year by the Bureau, disclosed losses of startling magnitude. It was found that in the few days in which crude oil is stored on the lease before being taken by the pipe line, the aggregate loss per year from evaporation amounts to about 122,000,000 gal. of gasoline in the Mid-Continent field alone. This has a value, at 22c. per gal., of $26,840,000, and represents about 3 per cent of the total gasoline produced in the United States from all fields and all sources. The Bureau found that a large part of this loss could be prevented by the use of efficient equipment.

The Bureau of Mines has pointed out the considerable losses which have resulted from the failure of many refineries to recover gasoline from uncondensed still vapors. The significance of this investigation is shown by the fact that one refinery in the Mid-Continent field is now recovering from still vapors approximately 400 bbl. of gasoline daily that before the installation of this equipment was either lost or burned as fuel under the boilers and stills.

Large quantities of gas are now being wasted in the Osage Nation Reservation in Oklahoma because of low-pressure conditions, and the Bureau of Mines is investigating the feasibility of utilizing this waste gas

by the use of low-pressure burners for oil-field boilers. The demand of the export market for "sweet" gasoline led to the development of a process for treating gasoline to remove the objectionable sulphur compounds, by which treatment some grades of American gasoline heretofore objectionable were made suitable for export.

Under the arrangement by which supervision of the drilling and production of oil and gas on the public lands is vested in the Bureau of Mines, the Bureau has supervision of about 100 oil properties which are producing at the rate of about 12,000,000 bbl. of oil per annum. Even at the present reduced price of oil, the Government royalty from this should total perhaps $2,000,000 per annum. A special process, devised at the San Francisco station of the Bureau, for cracking heavy oils and tars, promises the recovery of large yields of gasoline and other lighter products hitherto regarded as unrecoverable. Investigations made by the Bureau in Colorado and Utah indicate that the oil-shale deposits of the Rocky Mountain states contain a potential fuel supply of almost unequaled importance.

Helium Gas Studies

The experimental helium plant at Petrolia, Tex., conducted under the authority of the Army and Navy Helium Board, was in operation during the year at various times, and helium was produced for short periods. A study of the practicability of storing this gas in mine workings was made at the Bureau's experimental coal mine at Bruceton, Pa.

At the cryogenic or low-temperature laboratory in Washington, D. C., liquid air in quantity is now being produced. The primary object of this laboratory is to investigate gases and liquids at low temperatures, with special reference to the separation of helium from natural gas. Field investigations of possible supplies of helium in natural gas were completed during the year, every known gas field in the United States having been tested. Results were markedly successful, as they have shown that this country contains the largest supply of helium-bearing natural gas in the world.

During the year the Bureau, in cooperation with three of the largest seaboard coal exchanges, developed scientific systems of classifying export coals into pools by systematic sampling and analysis to supersede the arbitrary classifications used in wartime. Further progress was made in the investigation for preparing and utilizing lignite, which constitutes the greater part of the nation's fuel resources.

Work on preparation and analysis of special alloy steels for the Navy was also completed. A comprehensive report on recent developments in electric brass melting was finished.

Methods for preparing caustic magnesia were investigated which determined that high-grade magnesia can be made from some varieties of magnesite hitherto believed to be unsuitable for this purpose. The Bureau investigated dolomite as a substitute for the more costly magnesite in preparing refractories, and demonstrated that there can be obtained from Ohio dolomite a product superior in magnesia content to imported Canadian magnesite.

Experiments on Explosives

More experimental work on mining explosives, with reference to increased safety and efficiency, was performed. Plans were initiated for an international conference on the standardization of mine-rescue apparatus. Methods for reducing losses of anthracite in mining operations were studied. Timbering methods for metal mines were investigated. A special study was made of the ventilation of metal mines and of the rock-dust problem in such mines.

The Bureau called attention to certain methods for the prevention of waste in the slate-quarrying industry, and methods for reducing waste in the mining and preparation of talc were also made the subject of a report.

In the course of the year the Bureau trained 12,525 miners in rescue and first-aid methods, the largest number so trained in any fiscal year since the beginning of the training work.

Fall Meeting of St. Louis Section, A. I. M. E.

The St. Louis Section of the A. I. M. E. held a meeting at Rolla, Mo., on Nov. 4-5, in connection with the fiftieth anniversary of the Missouri School of Mines and Metallurgy. At the formal meeting of the section on Nov. 5 about fifty members and guests were present. The speakers were Mr. Graves, secretary of the student group at Rolla; M. M. Valerius, representing the Tulsa Section; A. C. Terrill, representing the Chicago Section; and T. A. Rickard, representing the San Francisco Section. Arthur Thacher spoke briefly on the value of Institute meetings, particularly to the younger members of the profession, and P. N. Moore spoke on the origin and function of the Federated American Engineering Societies.

Gold Medals for South African Research Work

At the ordinary general meeting of the Chemical, Metallurgical, and Mining Society of South Africa, held on Oct 15 at Johannesburg, S. A., four gold medals were presented under the terms of the society's Research Endowment Fund. The medal for Chemical Research was presented to James Moir, D.Sc. (Aberdeen), who has for several years been chemist in the Mines Department of the Union of South Africa. The recipients were in each case introduced by Prof. J. A. Wilkinson, a past president of the society. Dr. Moir, in responding, said he has now read one hundred papers, thirty-seven of which had been presented before the C. M. and M. S. of S. A. A medal for metallurgical research was awarded to William Arthur Caldecott, D.Sc. (Cape), and another to Henry A. White. These gentlemen are consulting metallurgists to the Consolidated Gold Fields and Union Corporation (A. Goerz) groups, respectively. The medal for mining research was awarded to John Innes for his able work on, and description of, the Kotzé Konimeter.

Minnesota Engineers Make Nominations

The November meeting of the Engineers' Club of Northern Minnesota was held at the Mohami Club, Virginia, on Nov. 26. The following nominations for next years' officers were reported: For president, J. H. McInnis, Virginia, and A. St. Vincent, Hibbing; vice-president, B. M. Concklin, H. E. Loye; secretary and treasurer, Robert McL. Johnson, R. J. Moore; directors, L. C. Moore, H. S. Rankin, O. A. Sundness, A. Tancig, F. R. Mott, P. F. Chamberlain, F. A. Pollock and H. R. McAdams.

W. H. Crago addressed the members on mining conditions in the Belgian Congo and detailed his experiences in that country.

Unreliable Potash Promotions in Texas

The National Vigilance Committee of Associated Advertising Clubs of the World has as a purpose "to create public confidence in advertising by making all advertising trustworthy." In its bulletin of Nov. 12 it thus summarizes its investigations on the advertising of the Cox Realization Co., regarding potash in Texas:

"Advertising of the Cox Realization Co., a potash project of the professional promoter, S. E. J. Cox, was the subject of investigation by the committee. A special bulletin was issued under date of Oct. 20. Considerable publicity has been given this report, although the Cox advertising was largely confined to letters and literature sent through the mails. The New York *Herald* devoted a front-page column to a story based on the special bulletin.

"Potash deposits claimed by Cox to have been discovered by the Cox Realization Co. when it was drilling for oil were advertised as 1,100 ft. thick. They were claimed to be in Martin County, Tex., and the committee's special bulletin quoted the U. S. Geological Survey to the effect that no authentic discoveries in potash beds of such thickness had been reported in Martin County, although they had men in the field who should know of them if any existed.

"The committee's bulletin has been the subject of several communications to the committee from Cox and his attorneys. Mention is made in the bulletin that the Federal Trade Commission cited Cox for unfair competition and the use of false and misleading statements in his advertising, in 1919."

Important Achievements of Geological Survey

In his annual report submitted to Congress on Dec. 7, the Secretary of the Interior lists the following among the important achievements of the U. S. Geological Survey during the last fiscal year:

Made field surveys and studies in ten states with a view to determining the occurrence of oil and gas; began the preparation of state maps showing oil and gas fields, and published maps showing the fields in Louisiana and Texas.

Continued co-operative geologic work with seventeen state organizations, with Hawaii, and with Haiti and the Dominican Republic, and co-operated in research with the U. S. Reclamation Service, Bureau of Mines, Forest Service, Federal Power Commission, and other Government organizations.

Made studies of ore deposits in ten states and prepared or began the preparation of sixteen reports on ore deposits or mining districts.

Continued studies of the structure and oil resources of the Osage Indian Reservation, in Oklahoma; prepared maps and reports on them for publication, and made further studies in other areas in that state with a view of directing successful search for oil and gas.

Studied deposits of oil shale in Colorado and Nevada and prepared for publication the manuscript of a general report on oil shales in the Rocky Mountain region.

Made studies of certain coal fields and prepared reports on fields in five states.

In a search for beds of potash salts in the Southwest, discovered at three localities two or more potash-bearing beds that may prove to be of commercial value.

Investigated nitrate-bearing clays in the Mohave Desert and in the valley of Colorado River and adjacent parts of southeastern California and began the preparation of a report on them.

Continued studies of mineral deposits in Alaska.

Made collections and examinations of fossils from twenty-one states for stratigraphic identification or correlation.

Made more than 2,500 analyses of rocks, ores, minerals, and waters.

Continued observations of temperatures in deep wells to determine temperature gradients in oil-bearing areas and in those not oil-bearing.

Continued the collection of statistics of mineral production and co-operated in this work with other Government organizations, with state organizations, and with industrial associations.

Continued studies of foreign mineral resources so far as these may compete with domestic resources or affect domestic industries.

Made reports on nearly 7,000 applications for oil and gas prospecting permits and reduced the oil and gas reserves by more than 60,000 acres.

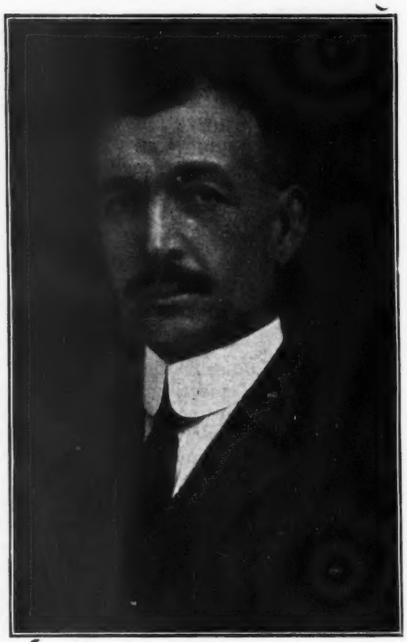
Made reports on 249 applications for coal-prospecting permits and 78 applications for coal leases and reduced the coal-land reserves by more than 200,000 acres.

Defined as leasing territory twenty-four oil and gas producing "structures" containing more than 230,000 acres.

Made more than 7,500 reports on applications under the mineral-leasing laws.

MEN YOU SHOULD KNOW ABOUT

James R. Finlay will make a thorough investigation of mining properties in New Mexico for the State Tax Commission, acting under authority of an act of the 1921 Legislature, which appropriated $30,000 for securing an expert valuation of all mining property in the state for purposes of taxation. Mr.



J. R. FINLAY

Finlay is now at Mogollon. Following his work there, he will devote his time to the properties of the Chino Copper Co. and the holdings of the Phelps Dodge Corporation at Tyrone, in Grant County.

Paul A. Gow was a visitor in New York this week, en route from Boston to Butte.

Charles Janin, of San Francisco, is making a trip to Washington, D. C., and New York.

Charles A. Mitke has returned to New York from South America and is en route to Bisbee, Ariz.

H. V. Winchell was recently in New York, and is now at the Iron Cap Mining Co., at Globe, Ariz.

F. J. S. Sur, petroleum geologist, recently returned to his San Antonio office, after having spent six weeks in New Jersey on geological inspections.

J. W. Sherwin, general manager of the West End Consolidated Mining Co. and allied properties, is in Tonopah from Oakland, Cal., making an inspection of the local property.

Frank L. Hess, of the U. S. Geological Survey, has returned from a trip through the uranium fields of Wyoming, Colorado, Utah, Arizona, and New Mexico. He will leave soon for Los Angeles.

James R. Jones, formerly a law examiner of the U. S. Bureau of Mines, and later an attorney with the Royal Dutch-Shell oil companies, has entered the private practice of law with offices at 327-328, Hynds Building, Cheyenne, Wyo.

H. B. Cobban, president of the Chamber of Commerce of Miami, Okla., has been appointed chairman for the month of December of the Tri-State branch of the American Zinc Institute, succeeding **P. R. Coldren**, who served in this capacity during November.

Dr. Alfred C. Redfield, assistant professor of physiology at the Harvard Medical School; **Dr. C. A. L. Binger**, of the Rockefeller Institute, New York; **Dr. George Harrop**, of the Presbyterian Hospital, New York; **Dr. A. V. Book**, of the Massachusetts General Hospital, and **Dr. Henry S. Forbes**, of Harvard University, are in Peru to undertake the first studies ever made of the physiological changes which enable people to live at high altitudes. The commission expects to remain two months in mining towns in the Andes Mountains.

A. J. McQuatters, of New York, is conducting a party of eastern capitalists on a visit to the silver mines of the Parral district, Mexico, in which he is interested. The visitors are **Louis E. Stoddard, J. L. Day, William H. Wright, Franklin Remington, J. F. Shaw** and **Dr. Kuno B. Heberlein.** The party was joined at El Paso by **S. E. Gill**, of Pittsburgh, president, and **J. C. Long**, general manager of the Parral & Durango Ry., and **James I. Long**, formerly general manager of the Alvardo M. & M. company. An inspection will be made of the latter property and also of the Refugio and the Hidalgo mining companies and the P. & D. Ry.

Mining and metallurgical engineers visiting New York City last week included **Chester A. Fulton**, Baltimore, Md.; **W. M. Small**, Tampico, Mexico; **Henry B. Smith**, New Britain, Conn.; **George A. Laird**, South America; **E. G. Robinson**, Youngstown, Ohio.; **Ralph H. Sweetser**, Columbus, Ohio.; and **Harry O. Robinson**, Mexico City.

OBITUARY

James A. Grainger, miner and prospector, died at Colfax, Cal., on Nov. 23. Together with **A. J. Stinson**, now state mine inspector of Nevada, Mr. Grainger located and did the preliminary development work on the Royal mine, at Rawhide, Nev. He was a native of Colorado and was forty-six years old.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Freight rates on ore and concentrates between California points and the Thompson smelter, at Wabuska, Nev., have been ordered lowered, thus enabling this plant to compete with the smelters in the Salt Lake Valley.

Lake shipments of iron ore for the season just closed were less than in any year since 1904, the total being a little over 22,300,000 tons.

Problems vexing the mining industry in Colorado are to be discussed at a conference to be held in Denver next month.

The bill for revising the United States mining law does not please the Northwest Mining Association, and a resolution has been passed analyzing the objectionable sections of the measure.

Appointment of a state geologist in Utah, an office at present non-existant, would aid the mining industry in the state, in the opinion of the Salt Lake Commercial Club, which will lay the matter before the Governor.

Blue-sky legislation is needed in Ontario, according to some operators in that province. Further study of the matter is to be made before any attempt at drafting a bill is undertaken, however.

Anaconda is doing important work in seeking a new outlet for its copper and zinc. New Cornelia has also been experimenting recently in making copper strips.

Want State Geologist for Utah Appointed

Salt Lake Commercial Club To Ask Governor To Create Position—Would Aid in Rejuvenating Mining Industry

The appointment of a state geologist for Utah and the creation of the permanent position of state geologist will be asked of Governor Mabey by the mining committee of the Commercial Club of Salt Lake City. Efforts are to be made to rejuvenate the mining industry, and the creation of such an office is expected materially to promote this object. It is felt that a proper channel is needed for the dissemination of information in regard to geological data, for which requests are constantly being made. It is planned also to establish a permanent mineral exhibit at the Commercial Club. The pamphlet recently issued through the Commercial Club, in cooperation with members of the local staff of the Bureau of Mines, entitled "Utah's Mineral Wealth," has been favorably received.

Freight Rates to Wabuska Smelter Reduced

The Interstate Commerce Commission, on Nov. 23, rendered an important decision which will reduce rates on ore from California points to the Thompson smelter at Wabuska, Nev. Hitherto the rates were favorable to Utah smelters and prohibitive to Nevada points, making it impossible for the Thompson smelter to operate on custom ore. The old rate was, for example, on ore running between $80 and $100 per ton, $10.70 per ton to Wabuska, or $1 per ton higher than to Utah smelters. The new rate has not yet been announced.

Utah Apex Decision Affirmed By Higher Court

The decision of the lower court upholding the claims of the Utah Apex Mining Co. in its litigation with the Utah Consolidated Mining Co. in the matter of apex rights has been affirmed by the U. S. Circuit Court of Appeals. The ore in dispute occurred in Utah-Apex ground, and was claimed by the Utah Consolidated as occurring in the Yampa limestone. The Utah-Apex claimed the ore as occurring in connection with its fissure system. Judge Johnson, in the Utah court, awarded to the Utah Apex damages of $1,200,000 last October. Additional hearings have been held on the matter of damages, and further accounting is in progress.

Lake Movement of Iron Ore Smallest Since 1904

The iron-ore movement by water from the Lake Superior district for the present season, which closed on Nov. 28, according to *The Iron Age*, was 22,300,726 gross tons, the smallest since 1904, when shipments by water were 21,226,591 tons. The 1921 shipments show a decrease of 61.86 per cent from those of last year, when water shipments amounted to 58,527,226 tons.

Broken Hill Mines To Increase Productive Work

By Cable From Reuters to "Engineering and Mining Journal"

Melbourne, Nov. 30—The Broken Hill companies have issued a joint statement to the effect that current metal quotations now permit the extension of underground operations. Accordingly, the North Broken Hill, the Broken Hill South, and the Broken Hill Proprietary companies have decided to increase their productive work as soon as practicable.

Protest Against Mine Law Revision Bill

Northwest Mining Association in Resolution Asserts Proposed Measure Would Make Present Situation Worse

A resolution passed by the Northwest Mining Association on Nov. 19 protesting against the revision of the United States mining law, as proposed in the bill introduced by Representative S. S. Arentz, which embodies the report of the Ingalls committee (H. R. 7,736), reads as follows:

"Whereas, a bill to revise, amend and codify the laws of the United States, relating to the location of mining claims on the public domain, is now before the 67th Congress and known as H. R. 7,736; and,

"Whereas, the purposes and probable effects of this bill, if enacted, have been carefully studied by competent committees of this association and have been adversely reported upon; and,

"Whereas, the existing Federal mining laws are now well and generally understood, as interpreted by the courts in the last forty-nine years, and have not proved to be sufficiently defective to require drastic revision. Now therefore be it,

"Resolved: That the Northwest Mining Association, representing mining interests in the states of Montana, Idaho, Washington, and Oregon, at a regular meeting in Spokane, Wash., Nov. 19, 1921, does hereby respectfully protest the passage of this bill on the ground that it is not competent to improve present mining conditions, but that, on the other hand, it would doubtless prove both burdensome and intolerable in several respects and make confusion worse confounded, as shown by the attached analysis which is hereby made a part hereof; and be it further

"Resolved that this association believes that no legislation should further handicap the mining industry at this time, but that it should be per-

mitted to recover from its present depression under the old and well-known statutes.

"Also, that copies of this resolution and the analysis of H. R. 7,736 be sent to each Senator and Representative of this region and to the chairmen of the Senate and House Committees on Mines and Mining, with an urgent request for their careful consideration."

In the analysis referred to in the resolution, objection is specifically made to the following sections and subsections of H. R. 7,736, namely, Section 5, A, B and C; Sections 6 and 7; and Section 13-A. A sketch showing the proposed manner of locating mining claims under H. R. 7,736 compared with the present system is also given. (This analysis will be published in full in next week's issue.)

Developing New Uses for Copper and Zinc

The Anaconda Copper Mining Co. has recently been doing a great deal of work with a view to widening the commercial application of copper and zinc. The advantages in employing zinc for all purposes where it can economically displace galvanized iron, and also in combination with asbestos for roofing purposes, is to be emphasized. For the latter purpose, it will be used as a filler between two sheets of asbestos. For shingles, both copper and zinc, colored by oxidation to any shade desired, will be produced to compete with tile. The weight will prove a great factor in their favor, especially where high freight charges are an important factor. It is understood that the Anaconda company will have these products on the market in the near future. An effort will be made to place the goods as directly in the hands of the consumer as possible. A popular advertising campaign is planned, and many selling agencies, which will also function as service stations, will be maintained. Prices will be stabilized and results guaranteed.

International Nickel Men Out

The executives of the International Nickel Co. of Canada, including A. D. Miles, president; G. E. Sylvester, assistant to the president; and W. M. Bennett, treasurer, have tendered their resignations. It is understood that Mr. Miles has also tendered his resignation as a director of the International Nickel Co., of New Jersey. The cause assigned is the depression in the nickel industry, which resulted in the discontinuance of the company's operations in the Sudbury field and the closing down of the Port Colborne refinery.

Use of Helium Demonstrated

The first practical demonstration of the use of helium in regular aircraft was successfully made Dec. 1 at Hampton Roads. The Navy's non-rigid airship "C-7," with a gas capacity of 181,000 cu.ft., was on that date inflated entirely with helium.

New Cornelia Experiments in Making Copper Strips

Colonel Greenway Describes Briefly Results Obtained to Date at Ajo

BY JAMES H. MCCLINTOCK

Phoenix — "We haven't what you would call plans thus far for any copper manufacturing enterprise at Ajo," says John C. Greenway, general manager of the New Cornelia Copper Co. "Any statement that would indicate the contrary is, at least, premature. I can only tell you what we have done. We have produced strips of copper 4 in. wide, 367 ft. long, and 37 gage, this meaning that the material is only 4/1000 of an inch thick. Such a strip will contain less than three holes to the ribbon, and the material is high in the points of strength and ductility. Our Ajo copper cathodes normally run 99.9 per cent pure. They need no refining for commercial uses, but usually are recast in New Jersey into commercial forms.

"In one thing," continued Colonel Greenway, "I feel that we have achieved success, this in the creation of a one-piece copper radiator of cellular type, something unique and much better than the one we made and tried out in our initial experiments. If this second effort proves what we hope it to be, we shall have done a big thing in this one item. We have tried the manufacturing of such things as road signs and of domestic implements, but everything yet is in an experimental stage, and, as I have said, any summing up of results would be premature."

Mine Merger on Cuyuna Range Rumored

It is reported that negotiations are under way for leasing the Cuyuna-Duluth mine by the Inland Steel Co., and that this property, together with the Armour mines, the Pennington (Todd-Stambaugh Co.), and the Kennedy and Meacham (Rogers-Brown Ore Co.), will form an independent ore-producing group on the Cuyuna, controlled by a proposed merger of several independent operators to be dominated by the Pickands-Mather interests. The Cuyuna-Duluth has been operated prior to this year by a subsidiary of the American Manganese Manufacturing Co. The property adjoins the Armour No. 2 mine of the Inland Steel Co.

New Concentrator at Clifton?

A report is in circulation in the Southwest to the effect that among the improvements under consideration by the Phelps Dodge Corporation in the Clifton-Morenci district of Arizona is a 15,000 ton concentrator to be situated somewhere between Morenci and Clifton, probably upon the Coronado railway tracks in the vicinity of Chase Creek. The company recently took over the Arizona Copper Co.'s property in this district.

Colorado Mining Men To Discuss Industry's Troubles

Conference To Be Held Next Month—Questionnaire Sent Out

Colorado mining men have been called to meet Jan. 17, 1922, to consider problems affecting the industry and to devise, if possible, such measures of relief as will assist in the restoration of the industry. A questionnaire has been sent out to the operators and miners of the state, and upon the answers received the program for the meeting will be based.

The principal questions are:

Name in order of importance the five principal contributing causes of mining depression in your district.

Can you suggest any remedy that can be worked out by co-operative effort of Colorado mining men?

Suggest in order of importance five subjects for consideration by the January meeting.

In your opinion, along what line should the state mining organizations direct their activities in the coming year?

Candelaria Mines To Get Mill of Rochester Combined

The news that the Rochester Silver Corporation had agreed to finance the construction of a milling plant at Candelaria for the Candelaria Mines Co., at Candelaria, Nev., has been confirmed by the president of the Rochester company. By the terms of the agreement the Rochester Combined mill, which was built three years ago, but which was never operated, is to be moved to Candelaria at once. It is reported that orders for lumber and supplies have been placed and that the mill will be ready about June, 1922.

Welsh Gold Mines Reopened

By Cable From Reuters to "Engineering and Mining Journal"

London, Nov. 28—Mining operations have been resumed at the Ologau gold properties at Bontddu, near Barmouth, Merionethshire, Wales. Work is being done on a level from which $300,000 worth of gold was taken in 1899.

Suit Against Inland Steel Co. Deferred

The suit of Thomas Keating Co., a foreign corporation, against the Inland Steel Co., a foreign corporation, which was on the civil calendar for November in the district court at Brainerd, Minn., on the Cuyuna Range, will not be heard until the May term of court. The Keating company, owning fee to mining property formerly under lease to the Inland Steel Co., claims $300,000 loss through improper mining methods and infringement of lease.

The week of Dec. 5 was Anti-smoke Week in Salt Lake City, Utah, in continuance of the effort successfully begun last winter to abate the smoke nuisance of the winter months.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Alaska's Prosperity Dependent on Mining Industry

Engineering Commission Emphasizes Importance of Development of Rail Transportation in Territory

That the growth of all industry in Alaska is dependent upon mining is pointed out in a report by the chairman of the Alaskan Engineering Commission submitted to Congress on Dec. 7. The report declares, however, that the mining industry is greatly handicapped by the lack of railroad transportation. It is predicted that the opening of the Government railroad will stimulate mining operations greatly. Chairman Mears says that the Copper River & Northwestern R.R., running from Cordova 192 miles inland to the Kennecott copper mine, has been a very profitable operation. He embodies in his report figures showing the operating expenses and revenues of that road from 1912 to 1916 inclusive, as follows:

Year	Operating Expenses	Revenue
1912.....	$301,383	$466,271
1913.....	575,060	433,561
1914.....	586,079	685,453
1915.....	481,281	917,760
1916.....	939,438	2,673,608

Continuing, the report says:

"It is reasonable to presume that much greater development may ultimately be looked for along the line of the Government railroad, as the resources tributary to the country are more varied and diversified in character, and the climate of the Cook Inlet and Tanana Valley regions is better suited to agricultural development and permanent settlement.

"One producing copper mine was sufficient reason for the expenditure of about $25,000,000 in the construction of the Copper River & Northwestern R.R. to transfer the ore to tidewater. With very little other resources this mine has made the railroad pay. If one or two good producing mines are developed in the country tributary to the Government railroad, or if the coal fields at Matanuska or Healy begin to produce tonnage on a commercial scale, both of which would have a tendency to develop the adjacent farming districts, it is believed that it would not be long before the new railroad would be on a self-supporting basis.

"To answer the specific inquiry as to the probable service of the railroad, it may be stated that a twice-a-week mixed train service in both directions is deemed sufficient to meet demands, supplemented by freight extras when necessary. By running trains twice a week, the interval between trains is not so great as to handicap the business of the country and would probably meet all demands for some time to come. In this way the operating expenses of the road would be kept at a minimum."

London Nitrate Sales Show Marked Increase

Large nitrate sales in London have greatly encouraged the Chilean producers, according to advices reaching the Department of Commerce. The agreement reached between the Nitrate Producers' Association and the Nitrate Pool, of London, caused a decided rise in the exchange value of the Chilean peso. A part of this gain was lost because of the report that the agreement provided for a material reduction of existing stocks in Europe before further exports were to be attempted. The recent brisk demand for nitrate, however, promises to consume the European stocks sooner than had been expected.

The consul at Iquique reports September nitrate production to have been 1,493,229 quintals. In September of 1920 the production was 4,501,850 quintals. The present rate of production is practically double the rate of exportation, with the result that stocks in Chile are increasing rapidly. The consul states that 29,000,000 quintals has been estimated as the probable 1921 production. The 1920 production of nitrate was 55,514,000 quintals.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended Dec. 3 totaled 1,714,000 fine ounces. This brings the total purchases under the Pittman Act to 84,759,863 fine ounces.

Interest Manifested in Mineral Leases and Claims

That there is great interest in mineral leases and claims is indicated by the figures covering these activities submitted to Congress on Dec. 7 by the General Land Office: As to mining claims 574 mineral entries and fifty-nine coal entries were received; also ninety-four mineral contests. As to prospecting permits and leases, twelve applications for sodium permits were allowed and ten rejected. Applications for potash prospecting permits received totaled 150, of which thirty-seven were denied. Fourteen applications for patent based on discovery were received, of which twelve were allowed. Oil prospecting permits received up to July 1 totaled 11,055. Of these 3,256 have been granted and 1,537 rejected.

Ask $3,381,525 for Bureau of Mines and Survey

Appropriation Sought by Each for Next Year's Work Represents Increase of $186,000 and $106,000 Respectively

Appropriations totaling $3,381,525 have been requested by the President and the Director of the Budget for the work of the Geological Survey and the Bureau of Mines during the next fiscal year. Of that amount, $1,721,060 is requested for the Geological Survey and $1,660,465 for the Bureau of Mines. The Survey's estimate represents an increase of $106,720 over the amount appropriated for its work during the current fiscal year. The Bureau of Mines' estimate requests $186,165 more than was appropriated for the current year's work.

The major divisions of the Survey's appropriation are as follows: Topographic surveys, $430,000; geologic surveys, $352,000; chemical and physical researches, $40,000; mineral resources, $125,000; mineral resources of Alaska, $75,000; gaging of streams, $180,000; geological maps, $140,000; classification of lands, $300,000. The major increase over last year's expenses is in connection with the topographic surveys, in which instance an additional $100,000 appropriation is requested.

The major divisions of the Bureau of Mines' appropriation are as follows: Investigating mine accidents, $414,065; testing fuel, $136,000; mineral mining investigations, $130,000; non-metallic investigations, $35,000; petroleum and natural-gas investigations, $135,000; mining experiment stations, $175,000; experiment station and mine inspection in Alaska, $35,000; operating mine rescue cars, $178,000; enforcement of oil leasing act, $162,000.

The increases asked, as compared with the amounts appropriated for the current year's work, are as follows: Investigating mine accidents, $5,000; mineral mining investigations, $5,000; enforcement of oil leasing act, $30,000. There was a reduction of $25,000 in the amount asked for the expenses of mining experiment stations and a reduction of $6,500 in the amount requested for testing fuel.

The Navy renews its request that $1,000,000 of its fuel appropriation be made available for its coal-mining operations in Alaska.

Reports on Mineral Applications

During the last fiscal year, the U. S. Geological Survey made 7,530 reports covering applications under the mineral leasing law.

NEWS BY MINING DISTRICTS

London Letter

Consolidated Gold Fields Passes Dividend—New Chairman Elected to Gaika Gold Board—West African Gold Property Shows Good Ore

BY W. A. DOMAN

London, Nov. 23.—Taking into consideration the depressed condition of the mining market during the last eighteen months or so, shareholders in the Consolidated Gold Fields of South Africa naturally looked for a reduction in profits for the twelve months ended June 30 last, but it is questionable whether they expected the dividend to be passed. This position is brought about by the heavy sums required for depreciation in investments held by the New Consolidated Gold Fields. To bring the shares down to market value, no less than £492,287 is required. This amount follows upon the writing off of £165,408 a year ago, and £194,335 in the preceding period.

Presumably the greatest amount of depreciation was in gold mining shares, though the company has placed large amounts of capital in industrial undertakings. Apparently little profit was derived from sales of shares, so that the bulk of the revenue of £429,984 was provided by dividends on investments. The company has invested about £188,000 in new undertakings, and has sold its gilt-edged securities. Unless the operating company can make a distribution for the current year the interest on the Consolidated Gold Fields preference shares is none too well covered.

Some of the companies in which the New Consolidated Gold Fields is interested have proved disappointing, particularly the American Trona and a South African coal deposit. The report gives a good review of the Rand mining industry, and points out the influence of the gold premium and the high wages paid for labor.

For October the Gaika Gold Mining Co. crushed 4,181 tons, for a yield of 1,400 oz. of fine gold, or about 6.7 dwt. per ton.

At 85/— per fine ounce the revenue was £5,950, and as working expenses were £5,263, the profit at normal was only £687. As, however, gold is taken at 100/— per oz., the profit amounts to £1,737. It will be seen that with costs at 25/2 per ton, the profit would have been negligible had there been no premium.

Although the production of tin in the Federated Malay States has been considerably curtailed, the quantity exported keeps up remarkably well. Last month's exports, 3,161 tons, were the highest of the year apart from January, when they were 3,298 tons. For the ten months to date, the total is 28,211 tons, as compared with 29,517 tons for the corresponding months in 1920 and 31,554 for the same period in 1919.

Though still satisfactory, developments at Lonely Reef in October were not on the high level of previous months. On the 23d level, north drive, the ground from 363 ft. to 423 ft. averages 36 dwt. over 44 in. In the next level below, north drive, from 203 ft. to 244 ft., the average is 18 dwt. over 59 in. During the month 5,100 tons was crushed, for a recovery of 4,610 oz. of fine gold, or 18.08 dwt. Costs were 48/4 per ton.

A little interest has been created in West African gold mining shares by the development results of the Obuom Concession of the Obbuassi Mines. On No. 5 level south of prospecting shaft samples taken every 5 ft. from 100 ft. to 125 ft. show: 18 in. 13.5 dwt.; 42 in. 30; 30 in. 45; 20 in. 35—a short but good run of ore. A winze sunk 160 ft. south of prospecting shaft from No. 4 to No. 5 level, a distance of 50 ft., shows an average width of reef of 23 in. and an average value of 150 dwt.

At the meeting of shareholders in the Gaika Gold Mining Co. there was a good deal of discussion on mining policy. A Colonial shareholder, who was well supported, succeeded in getting elected to the board in place of James Prinsep, the chairman and director and representative of the Consolidated Gold Fields and of the Gold Fields Rhodesian Development Co. The latter, which provides the technical management, is not financially interested in the Gaika. The new chairman intends to appoint a consulting engineer whose sole duty will be to attend to the Gaika.

CANADA

British Columbia

New Mining Association at Nelson Organized—Consolidated Men Visit Princeton

Princeton—A recent visit of J. J. Warren, president of Consolidated Mining & Smelting Co., and W. M. Archibald, manager of mines for the same company, to Princeton, where they were met by Emil Voigt, who has large copper holdings in the vicinity of Copper Mountain, has given rise to hopes of early activity in the Copper Mountain section. Nothing further to substantiate such hopes than the facts noted has been reported.

New Denver—The crew at the Bosun property of the Rosebery-Surprise Mining Co. has been increased to thirty men, now ranking second to the Silversmith as the largest employer of labor in the Slocan.

Nelson—Election of officers of the newly formed Mining Association of British Columbia, held at Nelson recently, resulted as follows: President, R. Randolph Bruce, Invermere; vice-president, Clarence Cunningham, Alamo; secretary-treasurer, W. H. Burgess, Kaslo; executive committee, S. S. Fowler, Riondel; T. W. Bingay, Trail; Major A. W. Davis, Nelson; J. P. McFadden, New Denver; W. T. McDowell, Ymir; Douglas Lay, Rossland; S. G. Blaylock, Trail.

Trail—Ore received at the Consolidated smelter from Nov. 15 to 21 totaled 7,449 tons, coming from the following shippers: Sally mine, Beaverdell, 36 tons; J. Anderson, Gerrard, 13; Paradise, Lake Windermere, 25; Surprise, Northport, 54; company mines, 7,272; and Van Roi, Silverton, 49.

Ontario

Advisability of Blue-Sky Legislation Studied—King-Kirkland To Increase Capitalization

Toronto—During the last year or so a great flood of wildcat stocks has been offered to the Canadian public, and the Province of Ontario has for some time had under consideration the enactment of a blue-sky or so-called "fraud law." The difficulty is to draft a law which will prevent the sale of wildcat stocks, but which will not prevent legitimate speculations.

A. H. O'Brien was commissioned by the Attorney General to investigate this matter, and has submitted an interim report. He advises that before attempting to draft a bill for the Legislature, existing types of similar legislation should be studied. Such laws are at present in force in three of the Western provinces, and also in several of the states across the border. If, after investigation, a bill then seems advisable, he holds, a tentative draft should be drawn and submitted to the various interests affected.

Cobalt—The Nipissing has dropped its option on the Edwards property, in Porcupine, as results were not satisfactory. Drilling is still being continued on the Rochester, but it is understood that the values found are not high. November silver production was good, but less than that of the previous month.

No ore was shipped from Cobalt over the T. & N. O. Ry. during the week ended Nov. 25. The Hudson Bay is sampling the Cane silver mines, near Elk Lake.

Ore running 7,000 oz. of silver has recently been struck on the Frontier property, in South Lorrain, now under option to the Mining Corporation.

Kirkland Lake—A special meeting of the shareholders of the King Kirkland approved the increase of the capital from 2,500,000 shares to 5,000,000 shares, par value $1, and the purchase of the Ferguson property for 450,000

shares. There will be over 3,000,000 shares in the treasury for future financing.

Recent development work on the Tough Oakes has been so satisfactory that the company is considering starting milling early in 1922. In the early days of the camp the Tough Oakes was the leading mine, its mill being the first to be built.

The Orr property, adjoining the Teck Hughes, is being sampled by engineers representing J. J. Godfrey.

In view of the recent discovery on the 900 level of the Kirkland Gold near the Elliott line, an amalgamation of these two properties is being discussed.

Porcupine—Dome is treating about 30,000 tons a month, and heads are averaging about $7. Sinking of the main shaft to 1,450 ft. will start soon.

MEXICO

Sonora

Cananea Paymaster Held Up—Moctezuma Copper Working 600 Men

Nogales — A paymaster of the Cananea Consolidated Copper Co. was robbed by two masked bandits of the payroll of $10,000 he was taking by auto from Cananea to the Chivatera camp. The hold-up came at a sharp turn of the road, where the bandits had all advantage of the paymaster and his guard.

At Nacozari and Pilares 600 men are employed by the Moctezuma Copper Co., a Phelps Dodge subsidiary, on development work, of which 2,500 ft. a month has been done since copper production stopped, and on construction of the new mill.

The Tigre and Las Chispas mines of northern Sonora are making ore shipments to El Paso through Douglas.

KOREA

Oriental Consolidated Output Increased

A clean-up of $101,940 was made in November by the Oriental Consolidated Mining Co. at its property at Unsankinko, Korea. That for October was $92,868.74. The company's Tabowie mill handled a smaller tonnage in October than could have been treated, owing to the fact that the native labor gave much trouble.

TEXAS

Chisos Quicksilver Mine Running—Sulphur Company Alters Plant

Terlingua—The Chisos quicksilver mine is working. The Study Butte and Mariposa properties were shut down several months ago. They are prepared to start up when the market improves.

Pecos—The Toya Valley Sulphur Co. has completed the installation of new retorts, and the new machinery will be tested this week. Imperfections in placing the original retorts caused a delay of several months in refining operations, although a large part of the sulphur ores have been ground into fertilizer.

ARIZONA

U. Y. Extension Appeals in Smoke Case—Arizona Copper Bids Employees Farewell

BY JAMES H. MCCLINTOCK

Phoenix—At Kingman an award of $20,000 was given by a jury to the plaintiff in the suit of the Wallapai Mining & Development Co. against the U. S. Smelting, Refining & Mining Co., the U. S. Smelting, Refining & Exploration Co., and A. P. Anderson. Notice of appeal was given to the state Supreme Court.

Appeal to the Supreme Court of Arizona has been made by the United Verde Extension Mining Co. from a judgment of $1 and costs, amounting to $1,620, secured in the Yavapai County Superior Court in a jury trial of an action preferred by David H. Biles and S. P. Wells, who had asked $2,557 for alleged damage to their crops on farms in the Verde valley from fumes from the defendant's smelter at Clemenceau.

In the Superior Court at Los Angeles, Cal., Charles T. Lindley, for himself and other stockholders, has sued the Jerome-Superior Copper Co. for an accounting and for $33,000. There are charges of unnecessary expenditures and of planning to oust directors and secure control of the corporation.

Miami—One of the three reverberatories of the International smelter is in operation, with consequent pouring of the first copper bullion produced in this district for seven months. The resumption was the cause of much public rejoicing, this including a "Pollyanna" banquet in which three civic organizations were sponsors. The run is to continue until the present stock of about 40,000 tons of Miami concentrates has been reduced.

Clifton—George Readman, chairman, and William Exley Miller, secretary, of the board of the Arizona Copper Co., Ltd., have issued a notice to the company's employees that "the whole of the business of the company in the United States, including the Arizona & New Mexico Railway Co., has been transferred to the Phelps Dodge Corporation," adding that, "the board bids farewell with great reluctance."

Clifton has been visited by a party of officials of the Phelps Dodge Corporation, including Walter Douglas. The property lately acquired from the Arizona Copper Co., Ltd., was inspected.

Pearce—The mill of the Commonwealth Mining & Milling Co. is running two shifts a day on ore from the company's mine, which is being operated under the lease system.

Tucson—The first mine in this section to resume production is that of the Yellow Bird Silver Mining Co., organized by S. W. Purcell, of Tucson, to develop property in the Papago district, thirty miles southeast, at historic Lincoln camp.

Yuma—The Arizona Barium Co. has been organized to work barytes claims in the Mohawk Mountains. The material is to be leached and roasted and the cinder shipped to Los Angeles for manufacturing uses.

Jerome—In connection with the visit of several stockholders, it is said that plans for the Dundee-Arizona include sinking a winze from the 960 level, where W. E. Defty, the engineer, intends to follow a gouge streak. More than 2,700 ft. of work had been done on the lowest level when the pumps were pulled.

Bisbee—With the payment Dec. 19 to shareholders of record Dec. 2 of a dividend of 50c. per share, Calumet & Arizona will have disbursed $2 per share this year. It has been able to do this because of the fact that it held something in reserve in its treasury during the "fat years" when liberal disbursements were made, but which were not quite satisfactory to many of the shareholders at that time. The wisdom of a conservative policy during that period has since been well demonstrated, in the opinion of George A. Newett, one of the directors. The dividends of the present year have not been made from this year's earnings, as is well understood, as no copper has been made since last spring, when the company's smelter was shut down. Several hundred men have been on the payroll since that time, however, for the main purpose of aiding labor, and which the company also was able to do because it had not drawn everything from its treasury. It has been conducting development and repair work.

No time for resumption has been set. The company has much less blister or refined copper on hand than many others, and will not have so much metal on which it can realize when prices become better. Its two-thirds interest in the copper surplus of New Cornelia is a considerable item, however, on which it will realize sooner or later.

NEW MEXICO

Great Eagle Co. Shipping Fluorspar—Hoisting Plant at Central Burned

BY JAMES P. PORTEUS

Lordsburg—The Great Eagle Fluorspar Co. shipped seven cars of ore during November. This product moved to the Pacific Coast, New England, and Chicago territory. The mill machinery has been overhauled, and mining operations under contracts have been started.

The Co-operative mine shipped two carloads of good-grade silver ore to the El Paso smelter. About twenty men are employed.

Steins—Development work on the Volcano mine is going ahead under the direction of C. E. Wheelock, who has twenty-two men working. Some good ore is reported to have been opened on the 100 level.

Central—Fire at the Lucky Bill mine on the night of Nov. 23, which was started by the ignition of oil from the heat of the engine exhaust pipes, destroyed the hoisting plant and the timbers in the shaft to a depth of 100 ft.

COLORADO

Ouray-Silverton Mail Route Discontinued—Bird Creek Company May Build Mill

Ouray—The Welch-Worland Mines Syndicate has completed its negotiations for the Wanakah mine and has taken over the property, which was a heavy producer a few years ago, but which has been idle for some time. The price of the mine is $175,000, under long-time lease and bond, and the first payment is being applied entirely to the debts of the Ouray Union Mining & Milling Co., who bought the mine this year and attempted to operate it, closed down, and sold out to the present operators. The mill is being overhauled and will soon be started on a moderate tonnage basis.

The Barstow, after a short period of idleness, has resumed, with the Ouray Leasing Co. and the Imogene Leasing Co. starting extensive development projects, under sublease from C. R. Wilfley, who also acts as manager of these companies. The upper level is to be extended by drifting ahead beyond the ore-shoot which made such good production this year, and the lower tunnel level is to be extended likewise, under the same ground.

The Lucky Twenty Mining Co. is now well started on its winter campaign of driving a crosscut to the vein on the Guadaloupe by air drills, with subsequent drifting on the vein. Results should be attained by next spring. James A. Lannon is manager. Stone, Hoffman, and Jackson, leasing on this property, are making shipments of very good silver-copper ore to the smelter. The Paymaster and Whitecloud companies, Hoffman brothers on the Guston, Andrew Meldrum, with a new prospect near the Guston, with the Barstow and Lucky Twenty, are the prospective winter operators of the Ironton-Red Mountain section.

The Post Office department has ordered the Ouray-Silverton mail route discontinued indefinitely. This is the first time in decades that the mail carrier, almost an historic figure, has not "bucked" the heavy snows of this road, carrying mail and small supplies to the many but scattered residents and operators of this isolated section. The discontinuing of this service will be a great hardship to the operators, and a vigorous protest is being made.

The Gold Bud Mining Co., of which Robert Kinley is superintendent, has been organized to operate the new discovery of gold made by Kinley and Davis north of Ouray last summer. Operations began on Nov. 26, when supplies were taken to the mine. Prospecting in the neighborhood of the Teller mine, on Corbett Creek, last summer, Kinley and Davis, old prospectors, developed a small vein in the sedimentaries, carrying free gold and giving good assays, an unusual occurrence in this part of the country. H. C. Fink, an attorney of Montrose, undertook the financing in and near Montrose, and raised money to start the enterprise, which will be watched with interest on account of its unusual geology.

Prospectors from Montrose last fall located a vein near the old Roscoe Conklin, near the head waters of Cimarron Creek east of Ouray, a wild and remote part of the county. Samples showed very high-grade gold ore.

Silverton—The richest ore shipped from the Silverton district this year was produced from the Giono lease in the Silver Lake property of the A. S. & R. Co. The twenty-five-ton shipment to the Durango smelter assayed 8 oz. gold, 70 oz. silver, and 24 per cent lead. The ore pocket from which the material was mined has not been fully developed.

Victor—During October, the Portland mill treated 23,440 tons of ore from mines and dumps, with an average value of $4.30 a ton. The total tonnage hoisted during the month was 46,340, compared with 39,404 during September. The average value of all ore hoisted was $8.77 a ton.

Silver Plume—The Wasatch Mining Co. has dismantled the Scotia mill, and has moved it to the Mendota mine. Rebuilding and remodeling are under way.

Creede—The Bird Creek Mining Co. is considering the erection of a twenty-five-ton concentrator. From the upper crosscut tunnel, which cut the vein at 1,100 ft., a drift has been advanced 300 ft. on a vein in ore assaying 30 per cent lead and 16 oz. silver. The vein is also opened by a lower tunnel at a distance of 2,800 ft. George S. Bentley is superintendent.

Boulder—A revival of mining activity has taken place in Boulder County, and numerous properties that have been idle for some time are being reopened. At a recent meeting of the Boulder County Metal Mining Association the following officers and directors were elected: Eugene Stevens, president; John R. Wolff, vice-president; E. B. Hill, secretary; Timothy O'Conner, treasurer; and J. W. Valentine, J. R. Pherson, J. G. Clark, Steven Corfield, Fred White, V. I. Noxen, William Todd, Guy Miller, J. E. Brock, Horace Atkinson, and A. W. Widdifield, directors.

NORTH CAROLINA

Coggin Gold Mine Resumes Operations

Ashboro — A ten-stamp mill recently built at the Pee Dee mine (formerly the Spoon), near Ashboro, is producing gold bullion from high-grade ore.

A small cyanide plant will be built at the Alred mine, near Gray's Chapel, for the treatment of concentrates.

Eldorado—The Coggin mine, near Eldorado, has resumed work after a year's shutdown, and is putting on men.

Hiddenite—It is reported from Hiddenite, in Alexander County, that the principal hiddenite gemstone mine has changed hands and that work has been resumed. Hiddenite is the emerald green spodumene gem, discovered in this region some years ago by W. E. Hidden.

UTAH

New Map of Alta District Published—Ventilating Water Lily Shaft Successfully

By Our Special Correspondent

Park City—Shipments for the week ended Nov. 26 amount to 2,110 tons. Shippers were: Judge allied companies, 911 tons; Silver King Coalition, 721; Ontario, 428; New Quincy, 50.

Alta—The South Hecla Mines Co. has published a new map of the Alta district. The South Hecla, which started out about eighteen years ago with eighty acres, has gradually increased its holdings until it controls about 3,000 acres. The map shows the new boundaries of the property.

Eureka—Ore shipments from the Tintic district for the week ended Nov. 24 amounted to 170 cars, as compared with 164 cars the week preceding. Shippers were: Tintic Standard, 55 cars; Chief Consolidated, 44; Victoria, 16; Dragon, 16; Iron Blossom, 13; Eagle & Blue Bell, 7; Centennial-Eureka, 4; Colorado, 3; Grand Central, 3; Empire Mines, 2; Mammoth, 1; Bullion Beck, 1; George Castleton, 1; Sunbeam, 1.

The Iron Blossom, which in 1920 operated at a net loss of about $3,400, has paid dividends of $25,000 this year. The property, in its heyday one of the largest dividend payers in Tintic, is now shipping silver-lead ores. These are going principally to the plant of the Tintic Milling Co.

The Tintic Standard mill is producing about 50,000 ounces of silver every thirty days, and making bi-monthly shipments. The present mill capacity, 160 tons daily, will be considerably increased by the addition of the two new roasters that are now in process of construction.

The ventilating pipes, which were placed as near the bottom of the Chief Consolidated's Water Lily shaft as possible, are solving the problem of ventilating it and of effectively reducing the heat. The shaft is down 1,300 ft. and will be continued to 1,600 ft. A monthly progress of 200 ft. or more is now expected.

Salt Lake City—The Sells Mining Co. has recently increased its capitalization from 600,000 shares, par value 25c., to 1,000,000 shares, par value 15c. Mine development is to be financed by the sale of treasury stock. At a directors' meeting held Nov. 22, it was decided to sell 412,446 shares of treasury stock to George H. Watson & Co., but before the transfer of this stock, stockholders are given the privilege of purchasing treasury stock at 3c. per share on the basis of two shares for every three shares of stock now owned, the right of purchase to be exercised on or before Dec. 22. The newly elected officers and directors are: George H. Watson, president and manager, John Zinc, vice-president; R. F. Marvin, secretary and treasurer; W. H. Weyher and V. S. Snow.

MONTANA

Anaconda Copper Considering Resuming Treatment of Zinc Concentrates—Davis-Daly Balks at High Smelter Costs—Better Feeling in Copper Circles

BY A. B. KEITH

Butte—Anaconda Copper interests have consulted both the Butte & Superior Mining Co., owner of the Black Rock mine and concentrator, and the W. A. Clark interests, operating the Elm Orlu and the Timber Butte Milling Co., with a view to resuming the treatment of customs silver-zinc concentrates, and it is considered not improbable that Butte & Superior may start production soon. Nothing is obtainable from local officials of the Butte & Superior regarding the situation, but from an eastern officer of the company comes a report of the corporation's intention to resume. Though there has been no substantial improvement in the zinc market, it is known that the Anaconda has found some demand for the metal of the quality which it produces by its electrolytic process, and with the company controlling the National Brass Co. of Ohio and possibly making headway in a program credited to it in obtaining some voice in the affairs of the American Brass Co., the presumption is permitted that the Anaconda will have more than one outlet for its zinc production, in addition to supplying the copper requirements of these two brass concerns, if plans work out. In this connection a local Anaconda official said that within two years there would be little produced by the Anaconda which would not be utilized in the manufacture of products with which the corporation was identified, and this was attributed as bearing upon the Anaconda's diversification program and entry into the field of merchandizing. Frederick Laist, in charge of the metallurgical end of the Anaconda, is achieving much in the way of improved recoveries at the company's electrolytic zinc plant at Great Falls, Mont.

The Davis-Daly—East Butte situation is nothing more than a refusal on the part of the Davis-Daly to continue to pay a smelting cost exacted by the East Butte at its Pittsmont smelter which is as high now as when the price of copper was 30c., according to opinion in circles friendly to the latter. Though it was necessary for the Davis-Daly to prosecute certain development work at the Colorado mine, some ore was mined, as chutes were raised in the orebodies every 30 ft. in order to be able to expedite the extraction of a large tonnage when the market warrants. When this was completed it was not considered good business to continue shipments unless an adequate profit could be realized, and under the present smelting schedule and low copper prices this could not be had, despite the generally high run of the copper content of the Davis-Daly's Colorado ores. There has been talk of efforts to bring about a consolidation of the two companies and rumors of an offer by the East Butte to exchange one of its shares for two of the Davis-Daly. Among some of the larger stockholders, it is intimated locally an even exchange will result in opposition which might reach the courts.

On behalf of the East Butte it is said that lower reduction costs will have to follow lower operating expenses, the smelter being faced by high costs of coke and smelter supplies generally, and to reduce its charges would necessitate a wage reduction. The East Butte smelter is continuing to operate on a surplus stock of concentrates and on its own ores.

Philipsburg—The Philipsburg Mining Co. is making definite plans to install a magnetic separator to treat its manganese ores. At present the company is making a chemical grade of manganese with its wet concentrator. After April next the wet concentrator will be used to concentrate lead-zinc-silver ores from the Granite Bimetallic mine, when it is believed the magnetic separator will be ready for operations.

NEVADA

Hornsilver Mine Said To Have Cut Good Ore on 700 Level

Hornsilver—The official report from the mine states that the southeast drift on the vein from the shaft crosscut on the 700 level has entered good ore. The drift shows 6 ft. of ore, 2 ft. of which should assay $100 per ton, the other 4 ft. being ore of milling grade. This ore is regarded as a part of the shoot developed on the 600 level.

Tonopah—The Tonopah Belmont bullion shipment representing production for the first fifteen days of November was $145,000. The Tonopah Extension has ordered two Aldrich 600-gal. triplex pumps for installation on the 1,540 level of the McKane shaft. The water is to be pumped direct to surface through a 10-in. column. In the Cash Boy mine the winze being sunk on the south dipping vein entered 7 ft. of $40 ore at a depth of 60 ft. below the 1,645 level. A crosscut on the 1,785 has 70 ft. to go to reach the projected position of the orebody on this level.

Battle Mountain—The Betty O'Neal mine is being developed through a series of raises driven from the 150 level of the shaft to a connection to the old tunnel workings. Drifts were extended on the Estella vein, and good ore is said to have been developed. The shaft is 300 ft. deep, but work is at present confined to the 150 level to avoid the costs of pumping. The water is to be drained later by a tunnel, and development work will then be started on the 300 level.

Ely—The Boston & Ely will soon increase its working force. S. M. Soupcoff, field engineer for the A. S. & R. Co., and Raymond Guyer, consulting engineer for the Ely company, have recently recommended that the property be thoroughly proved.

The Hamilton district is now shipping a substantial tonnage of lead ore to the Utah smelters.

MINNESOTA

Cuyuna Range

Season's Shipments Now Completed—Inland Steel Co. Alone Mining Ore—Surface Improvements at Sagamore

Crosby—Cuyuna Range mines completed lake shipments for the season Nov. 19. The range is credited with a total production of 485,058 tons, as compared with 1,870,253 for the year 1920. Individual shipments were as follows: Armour No. 2 mine (Inland Steel Co.), 214,040 tons; Hillcrest (Coates & Tweed), 116,072; Mahnomen (Clement K. Quinn & Co.), 42,272; Kennedy (Rogers-Brown Ore Co.), 36,383; Meacham (Rogers-Brown Ore Co.), 35,035; Croft (John A. Savage Co.), 29,726; Cuyuna-Duluth (American Manganese Manufacturing Co.), 10,208; and Maroco (Marquette Ore Co.), 2,322.

The Inland Steel Co. is at present the only operator mining ore on the range. At its Armour No. 2 mine stockpiling for the winter has been begun, with a full crew on double shift. Although no definite plans have been announced, it is anticipated that the Rogers-Brown Ore Co. may resume operations at either its Kennedy or Meacham mines before the winter season is over. The company has a residue in stockpile at its Kennedy mine of 70,000 tons and about 30,000 tons at the Meacham.

Trommald—Hydraulic stripping at the open pit of the Marquette Ore Co. is held up indefinitely owing to inability of the Cuyuna Range Power Co. to supply necessary electric power. Stripping has been continued with two steam shovels.

Mesabi Range

Oliver To Strip Little & Prindle Property—Harrison Concentrator Shuts Down

Keewatin—The Oliver Iron Mining Co. has started operations for the stripping of its property known as the Little & Prindle. Tracks are now being laid from the pit to the dump, and practically all machinery, such as steam shovels and locomotives, is at the property. All other properties in this locality are idle.

Nashwauk—The Harrison concentrator, operated by Butler Bros., has ceased operations for this season, due to cold weather. The work in the Harrison pit and at the concentrator continued after the shipping season closed as the ore was placed in stock. No doubt advantage will be taken of this arrangement in the early spring before the shipping season starts next season. The closing down of this work affected 250 men.

Aurora—The Miller mine, operated by the Pitt Iron Mining Co. is at present operating on only one shift, as the night shift has been discontinued. All stripping operations in the Miller pit has also been discontinued for an indefinite period. The company has notified its employees that married men will be given the preference in all work. until further notice.

ALABAMA

Unemployment Greatly Decreased—The Shannon Deep Mining Project—Raimund Mine May Resume

By George Huntington Clark

Birmingham—The Birmingham district continues to lead other steel centers in percentage of production. The present activity of the U. S. Steel Corporation at large is stated authoritatively to be 52 per cent of capacity, and that of independents at 40 to 50. Compared with this, the Tennessee Coal, Iron & Railroad Co. has been for some time on a 55 per cent basis. The explanation of this activity mainly lies in the resumption of long withheld railroad buying, both domestic and foreign.

Unemployment under existing conditions has shown a decrease, district payrolls for October recording an increase of 5.2 per cent, or an increase of men employed from 22,344 to 23,497 during the month.

The improved position of Gulf States is beginning to be better appreciated. Three of the six open-hearth furnaces of this company were blown in on Oct. 30, and all departments are now active except the iron furnace, which, it is stated, may be blown in before the close of the year or early in January, 1922.

Attendant upon the operation of this furnace will be a resumption of operations at the Shannon mine, shut down when the furnace went out of blast.

The Shannon is the initial deep-mining project in the local red ore, as distinguished from the hitherto universal practice of developing by means of slopes sunk from the outcrops on the summit of Red Mountain. A drill hole sunk several miles back from the outcrop showed at a depth of 1,930 ft. over 19 ft. of largely self-fluxing ore. The upper and lower bench of the big seam were found to have only a 3-in. parting. The Gulf States company subsequently acquired this property, and opened it up by means of a slope 2,816 ft. long, terminating at a vertical depth of 2,073 ft. in an orebody found to be 20 ft. thick at this point and of self-fluxing ore.

The slope is a 10 x 18-ft. double-compartment concrete-lined incline, carrying a double track and airway, equipped at the foot with a complete and modern loading plant, similarly of concrete. The orebody entered at the base of the slope, having basined out at this distance back from the Red Mountain outcrop, has here very little dip, and has been systematically opened up by entries and rooms, the entire 20 ft. of the vein being taken out. At the time of shutting down, an output of 400 tons per day was being made, and the mine is estimated to have a capacity much in excess of any anticipated requirements of the company for an indefinite period.

There are indications that the Raimund iron mine of the Republic Iron & Steel Co. on Red Mountain may resume this month.

JOPLIN-MIAMI DISTRICT

O. K. Chandler Heads Indian Agency—May Discontinue Miami Office

By P. R. Coldren

Joplin—A government appointment of interest in the Tri-State zinc and lead field last week was that of Oliver K. Chandler, of Claremore, Okla., to the position of superintendent of the Quapaw Indian Agency, a place made vacant by the death of Carl F. Mayer, several weeks ago.

A large part of the rich zinc and lead lands of Ottawa County, Okla., the heaviest producing section of the Tri-State district, is owned by Quapaw Indians, and for this reason the appointment was of special interest in this field. Mr. Chandler has been in the Indian service for fourteen years, and at the time of his appointment was field clerk for seven counties, with office at Claremore. He was at one time secretary to Congressman C. E. Creager, of Muskogee.

It has been rumored lately that the Indian office at Miami is to be discontinued in favor of the office at Wyandotte, Okla., the original home of the Quapaw agency. Another rumor now is to the effect that the Miami office is to be continued and the Wyandotte office discontinued. It is expected that something definite will be announced as to this as soon as Mr. Chandler assumes office.

The recent taking over of the Huttig Milling Co. at Kansas City by the Commerce Trust Co. will not, it is announced, in any way effect the operation of the Huttig Lead & Zinc Co. in this field. William Huttig is at the head of both companies. The Huttig company has been one of the large producers of zinc ore in this district, and has never stopped production. It is also developing a promising tract to the north of Crestline, Kan., which it plans to develop later. B. E. Brown is manager for the company here.

SOUTHEAST MISSOURI

Four Producers Active—Planning Mill for New Mine at Annapolis—No Mining in Madison County

St. Louis—There is a fair amount of activity among the four large producing companies of the disseminated lead belt in southeast Missouri, operating at 65 and 75 per cent capacity. Though the price of pig lead in the St. Louis market, 4.35c. per lb., would yield an attractive margin of profit under normal conditions, the present high rates for labor, coal, and supplies leave such a small margin of profit as to render it undesirable to push production. Labor costs have been reduced twice since the peak of war prices, but living conditions have not declined sufficiently to warrant another cut. After next spring, when a new contract will be made with the Illinois coal mines at probably a considerable reduction in wages, under a new two-years' contract, a material reduction in coal prices will probably be effected. The district is now receiving its coal supply direct from the Sparta district over the revivified Illinois Southern R.R. at a marked reduction in freight rates over the shipments through the St. Louis gateway. At the Herculaneum smelter of the St. Joseph Lead Co. only two of the four stacks are in operation, but a third stack will, it is expected, be blown in within the next thirty days.

There has been little diamond drilling carried on during the last season, and all the drills have now been called in, as usual, for the winter.

The new lead mine at Annapolis, on the main line of the Iron Mountain R.R., in Iron County, has been closed down after completing its shaft. Plans are being drawn for the erection of a 500-ton mill, which will probably be erected on this property next spring.

No mining is being done in Madison County, and the properties of the Missouri Cobalt, Mine La Motte and the Catherine companies have been closed down for some time.

Chronology of Mining

November, 1921

Nov. 3—Hearing on accounting proceedings between Butte & Superior and Minerals Separation opened in New York, lasting until Nov. 16.

Nov. 4—Wisconsin State Industrial Commission held public hearing in Platteville on proposed safety regulations for mines.

Nov. 5—Gold miners on the Rand, South Africa, threatened to strike over proposed increase in proportion of native labor employed. Dispute was compromised later in month.

Nov. 12—Boston & Montana Development Co. started new concentrator at Elkhorn, Mont.

No. 14—Davis-Daly Copper Co. suspended production, owing to high smelting charges.

Nov. 15—Simon Silver-Lead Mines Co. started new mill at Simon, Nev.

Nov. 17—Emergency tariff act signed.

Nov. 20—One reverberatory started at International smelter, Miami, Ariz., storage space for concentrates having been completely filled.

Nov. 21—Steel & Tube Co. of America resumed operations at its Newport and Palms-Anvil mines, in Michigan.—Day-Smith injunction suit to prevent joint operation of Star mine by Hecla and Bunker Hill & Sullivan companies began in Spokane. Suit adjourned a few days later.

Nov. 23—Tax Revision bill (H. R. 8,245) signed.—War Minerals Relief bill signed.

Nov. 24—Announced Alaska Railroad had been completed between Anchorage and Fairbanks.

Nov. 28—Hearing held at Coeur d'Alene, Idaho, on matter of compensation due Star Mining Co. from Federal Mining & Smelting Co. for ore alleged to have been illegally extracted.

The Situation at the Mines in November

ASIDE from the copper camps, the situation in most metal mining districts in November compared favorably with that in October and in some districts showed improvement. There was no marked distress from unemployment, though labor was said to be plentiful, in general.

Conditions at the copper camps in the West were practically unchanged. Ray, Chino, Utah, and Nevada Consolidated confined their operations to turning their mills over twice a week to keep the tables from warping. The last named also proceeded with the development of its high-grade orebody. The Phelps Dodge Corporation stopped work on its Sacramento Hill project on Nov. 1, slightly decreasing its force in the Warren district, which had been about 1,200 men. All other branches of the company were down tight. About 400 to 500 tons of ore was taken daily from the fire zone at its Coronado mine at Morenci.

Operation by the International smelter on stored Miami concentrates was the only change in copper activities in Arizona during the month. This yielded 1,647 tons of bullion. Inspiration and the smelter added 300 men. Miami's mill output was little changed from October, being equivalent to about 4,500,000 lb. of copper. New Cornelia's cathode copper production was 1,600,000 lb., slightly over October. Production in the Southwest was confined to these two.

In Montana, at Butte, Davis-Daly stopped production. East Butte operated one furnace, in part on surplus concentrates, though talking of suspension if sufficient custom ore could not be obtained. Anaconda's smelters remained down, the company producing no copper but its regular output of zinc. The A. S. & R.'s East Helena plant ran two furnaces (lead). In British Columbia the Granby smelter ran at about 90 per cent of capacity. There was also activity in the Plumas County copper district of California.

All smelters in northern Michigan showed an increase in production of refined copper in November, the output being estimated at 8,000,000 lb., or approximately 36 per cent of normal. The month closed with fifteen furnaces in blast, against eleven in October. Of these, Quincy had one, Michigan three, and Calumet & Hecla eleven. Copper Range and Quincy increased working forces slightly. Relief for the unemployed, where needed, was available. The total number employed was about 25 per cent of normal.

In Tennessee, the Ducktown Sulphur, Copper & Iron Co. ran its smelter at normal capacity, and its new mill handled the largest tonnage to date. In general there was a slight increase in capacity over October. There was, however, some unemployment in the district owing to the fact that Tennessee Copper ran considerably below capacity.

Mining in the Black Hills of South Dakota showed improvement, with the labor situation better. The Homestake and Trojan companies ran at capacity. The former's gold and tonnage output was the same as in October. Trojan produced $28,000 in gold bullion from 5,810 tons of ore, compared with $26,000 from 6,150 tons in October. Other smaller operators were active.

The outstanding feature in Colorado was the number of new companies organizing to open up properties long idle. The American Smelting & Refining Co. reported increasing receipts of ore. Output from Cripple Creek, Telluride, and Ouray continued to improve, with no appreciable decline in other districts. The labor situation was fairly good.

Shipments from Utah camps increased slightly during the month. Park City shipped 8,330 tons of ore and concentrates, against 8,139 in October. This was average normal production. Bingham's output was unchanged around 15,000 tons. The Tintic output was 33,012 tons, compared with 31,350 in October. There was little change in the smelting situation except around the middle of the month, when the smelters became overstocked with siliceous silver ores, causing some Tintic mines to curtail. Midvale ran three lead furnaces and Murray three. Garfield ran three reverberatories. The labor situation remained good.

Conditions at most Nevada camps were about the same as in October, with indications of future improvement. The Simon Silver-Lead Mines Co. started its new mill, and steps were taken to finance the building of a new cyanide plant at Candelaria. Royston, Hornsilver, and some other small camps were active. The situation was good at Tonopah and Divide, and output normal. The Comstock was busy.

Tonnage shipped from the Cœur d'Alene district, in northern Idaho, was a little larger than in October, owing to a 10 per cent increase in the output of the Hecla company, which produced between 3,800 and 3,900 tons. The Bunker Hill & Sullivan and the Federal companies produced a normal tonnage of 6,000 and 4,700 tons, respectively, unchanged from October. Significant of further improvement was the blowing in of a second furnace at the Bunker Hill smelter on Nov. 25, this bringing the daily tonnage handled at this plant to 600. Important leasing operations were under way. The labor situation was unchanged, the supply being equal to the demand, with few men idle.

On the Coast, conditions were unchanged from October, no events of economic importance occurring. The Tacoma and Trail smelters continued to operate on a curtailed basis, and the Northport plant remained down. In California gold mining continued its slow recovery, the copper districts remaining dead except in Plumas County.

Zinc-ore surplus was decidedly reduced in the Joplin-Miami district in November, not exceeding 65,000 to 70,000 tons at the end of the month. Purchases exceeded production, which was rated at 5,500 to 6,000 tons per week. At the close of the month it was announced that the Illinois Zinc Co. would re-enter the buying market after being out a year. Several retorts at the American Metal Co.'s Bartlesville smelter were started. Activity was retarded by impending decreases in ore freight rates. The labor supply remained adequate, practically all miners being employed.

In the southeast Missouri lead district operations were conducted at 65 to 75 per cent capacity. Despite a price for lead normally attractive, labor, coal, and supplies remained high, leaving a profit so small as to make it undesirable to push production. Wages were about 30 per cent above pre-war normal, comparing favorably with the present cost of living. Plans were being drawn for a 500-ton mill for the new lead mine at Annapolis.

In the Wisconsin zinc-lead district operations continued as in October at full capacity. Production is estimated at 2,500 tons of crude blende concentrates, 1,000 tons roasted blende concentrates, and 250 tons lead ore. Five producers were active; also one roaster, one acid plant, and one oxide plant. One mill was under construction and one mine preparing to open. Seventy-five individuals were engaged in prospecting. Blende concentrates in bins were equivalent in tonnage to 25,000 tons of roasted ore. The demand for ore was light, with another lull at the end of the month. Miners who left last spring were gradually returning.

Iron-ore shipments from Lake Superior ports for the lower lakes were completed for the season during the month, bringing the total tonnage for the year to about 22,300,000. The attitude of operators was more cheerful on the Michigan ranges than a month ago, work being resumed at several mines and the scale of operations increased at some others. In Minnesota, the open-pit mines shut down for the winter, except for stripping work. A few Mesabi underground mines continued on part time. All Vermilion Range properties worked, but on a reduced basis.

In the Birmingham district eleven stacks remained in blast unchanged from October, during which month five furnaces were started. Stocks of pig in furnace yards on Nov. 1 showed a reduction of about 12 per cent compared with October. Ore production for the month reflected steel-making conditions.

In Ontario, in the Sudbury district, the International Nickel Co. laid off a large part of its staff. The Mond continued a limited production. At Cobalt, producers maintained their output, the situation being basically strong. Kirkland continued active. The Ontario Kirkland mill was completed. Production of the camp is increasing slowly. Porcupine continued to set new production records. Heavy rainfalls gave assurance of a plentiful supply of power, and McIntyre decided to add a 250-ton milling unit. Hollinger's daily tonnage increased to over 3,800. Labor was plentiful.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
1	13.375@13.50	30.375	30.50	4.70	4.35	4.70
2	13.375@13.50	30.625	30.875	4.70	4.35@4.40	4.75@4.80
3	13.375@13.50	30.625	30.875	4.70	4.35@4.40	4.80
5	13.50	31.375	31.625	4.70	4.35@4.40	4.85
6	13.50	31.375	31.75	4.70	4.35@4.40	4.85@4.90
7	13.50	31.25	31.50	4.70	4.35@4.40	4.85@4.90

*These prices correspond to the following quotations for copper delivered: Dec. 1, 2, 3, 13.625@13.75c.; Dec. 5, 6, 7, 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
1	67⅛	68	75½	163¼	165⅛	26	25¼	26½	27
2	67	67⅞	75	164⅝	166¼	25¼	24⅝	26¼	26¾
3	....	....	....	....	....	....	....	....	....
5	67⅛	68	75	167	168¾	25⅜	24½	26¼	26¾
6	67½	68⅛	75	167⅝	169¼	25⅜	24⅝	26⅜	26¾
7	67⅜	68¼	75	167¼	169	25⅝	24¾	26¼	26⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver			Dec.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
1	402½	99⅝	68	37⅝	5	405	99⅝	66¼	36⅝
2	404¾	99⅝	67⅞	37½	6	407	99⅝	66½	36⅜
3	404½	99⅝	67	37¼	7	408¼	99⅝	66¼	36⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Dec. 7, 1921

All metal producers were cheered by the developments of last week. The prices of copper, lead, zinc, and tin all showed firmer tendencies, and the hope of settlement of international difficulties seems a little brighter.

Copper

The price has again advanced, both in the outside market and among the large producers. Most of the metal sold during the last week has netted producers about 13.50c., f.o.b. refinery. The delivered price generally quoted for December and January shipment has been about 13.75c., but this has been shaded slightly on desirable business where the freight rate is not high; or in other cases this price has been quoted for forward deliveries. Producers generally are unwilling to quote beyond February at current prices. Domestic business has been of about the same volume as during the last two months but export sales have fallen off somewhat, largely owing to financial conditions in Germany. Inquiries have picked up somewhat in the last three days.

Lead

Most of the business has been done in the Middle West during the last week. Chemical lead has found a ready market in St. Louis at 4.35c., and some has sold as high as 4.40@4.425c. reduced to St. Louis basis. Desilverized has commanded considerably higher prices, but not enough has been sold to establish exact quotations. New York business has been done all week at 4.70c., which remains the official contract price of the American Smelting & Refining Co. Some reports of outside sales at 4.75c. have been heard, but by far the largest business has been done at the lower level. The market looks stronger, however, and it would appear that intending purchasers can make no mistake in buying at current levels. Several large orders are expected to be placed within the next few days.

Zinc

The market rose steadily during the week, but producers are at a loss to explain what caused the advance, as sales have not been much heavier than for the last few weeks. The rise induced several important producers to dispose of some metal at 4.85c. who had formerly kept out of the market. Inquiries have not been noted in any large volume. Zinc was sold yesterday at 4.90c., the price that is being generally quoted today. Business from brass mills is reported to continue its improvement. High-grade zinc is still going forward at 6c., delivered.

Tin

The market was active up till today, with a great demand for prompt metal from tin-plate interests, many of which are reopening their mills or increasing production. The London prices have advanced, no doubt partially because of better business reports from this side, and the price of sterling exchange has taken a violent spurt upward. There is little tin now being produced in this country and still less on the market.

March deliveries of Straits were quoted as follows: Dec. 1st, 30.375c.; 2d, 30.625c.; 3d, 30.625c.; 5th, 31.375c.; 6th, 31.125c.; 7th, 31.625c.

Arrivals of tin, in long tons: Total for November, 2,525; Dec. 1, Straits, 5; 5th, Straits, 275; 6th, Straits, 325.

Gold

Gold in London: Dec. 1st, 102s. 7d.; 2d, 101s. 3d.; 5th, 101s. 8d. 6th, 101s. 2d.; 7th, 100s. 6d.

Foreign Exchange

Several items in the news of the week affected the European exchanges favorably and marked advances were generally recorded. On Tuesday, Dec. 6th, francs were 7.60c.; lire, 4.3925c.; and marks, 0.505c. New York funds in Montreal, 8⅛ per cent premium.

Silver

Since our last report the price of silver in London has dropped steadily. The New York market has also fallen, and the decline would have been greater had it not been for the strength of sterling exchange. Both the rupee rate and China exchanges have fallen, with the result that buying from the Far East has been on a small scale and competition between India and China was negligible. The market closes quiet, with no factors in evidence which might tend to improve the price.

Mexican Dollars—Dec. 1st, 51¾; 2d, 51½; 3d, 51½; 5th, 50½; 6th, 50⅝; 7th, 50¾.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.50c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Bismuth—$1.50@$1.55 per lb.

Cadmium—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt—Metal, $3@$3.25 per lb.; black oxide, $2@$2.10 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35@38c. Market dead.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$55@$70 per oz. Nominal. $70 Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—Declined to $75@$78 per oz. Market quiet.

Quicksilver—$48 per 75-lb. flask. San Francisco wires $47.50. Market improving.

The prices of the following metals remain unchanged from the figures published in these columns on Dec. 3: Rhodium, Selenium, Thallium, and Tungsten.

Metallic Ores

Manganese Ore—23@24c., per unit, seaport; chemical ore, $55@$60 per gross ton, lump; $75 per net ton, powdered. Nominal.

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Dec. 3 issue: Chrome, Iron, Magnetite, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 3—Zinc blende, per ton, high, $28.85; basis 60 per cent zinc, premium, $26. Prime Western, $25; fines and slimes, $23@$22; average settling price, all grades of blende, $25.25.

Lead, high, $58.95; basis 80 per cent lead, $52.50@$54; average settling price, all grades of lead, $55.43 per ton.

Shipments for the week: Blende, 7,317; lead, 1,630 tons. Value, all ores the week, $276,130.

Purchases dropped from 13,800 last week to 7,500 tons this week, and shipments were 800 tons lower.

With shipments 7,300 to 8,500 tons per week and production around 6,000 tons, the reserve stock is shown to be moving outward. National Zinc, having secured a favorable court decision on the gas rate at Bartlesville, was in the market for a considerable tonnage. It is said that American Metal, also benefited by the lower rate, will restart furnaces at Bartlesville.

Federal Lead has stopped the downward march of lead ore by coming in with a capacity to absorb several thousand tons. Rumors of a price as high as $55 basis are heard, but $54 basis is known to have been paid.

Platteville, Wis., Dec. 3—Blende, basis 60 per cent zinc, $28. Lead ore, basis 80 per cent lead, $55 per ton. Shipments for the week, none. Shipments for the year: Blende, 10,719; lead ore, 1,763 tons. Shipped during the week to separating plants, 431 tons blende.

Non-Metallic Minerals

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. Market quiet.

Graphite—Ceylon lump, first quality, 5½@6½c. per lb.; chip, 4@5c.; dust, 2½@3¾c.; No. 1 flake, 5@7c.; amorphous crude, $15@$42.50 per ton. All f.o.b. New York. Market reported weak, with absolutely nothing doing. Large consumers appear to be well stocked in advance of immediate needs. Shaded prices fail to move buyers, who claim to have no use for the material at present.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia. Market is reported quiet in the South and poor in the North. August, September, and October were good. November and so far in December are on a par with first part of 1921, and unsatisfactory.

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Dec. 3 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Fluospar, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur, and Feldspar.

Mineral Products

Arsenic—7@7¼c. per lb., f.o.b. New York.

Potassium Sulphate—Powder, domestic, 90c.@$1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.30 per cwt. ex vessel, Atlantic ports.

The price of sodium sulphate and copper sulphate is unchanged from the quotations published Dec. 3.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 12c. per lb. of chromium contained; 4 to 6 per cent carbon, 13c., f.o.b. works.

Ferromanganese—English and German, $58.35@$54, c.i.f. Atlantic seaports. Other quotations unchanged.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Dec. 3 issue: Ferrotitanium, Ferrocerium, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium, and Ferrovanadium.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 15@15.25c.

Yellow Metal—Dimension sheets, 17.75c.; sheathing, 16.25c.; rods ⅜ to 3 in. 14.75c.

Lead Sheets, Nickel Silver, and Zinc Sheets unchanged from Dec. 3 quotations.

Refractories

Prices on the following are unchanged from the figures published in the Dec. 3 issue: Bauxite Brick, Chrome Cement, Chrome Brick, Fire Brick, Magnesite Brick, and Silica Brick.

The Iron Trade

Pittsburgh, Dec. 6, 1921

Practically all branches of the finished-steel trade show lighter demand and declining production, with two conspicuous exceptions, tubular goods and tin plate. There may be a decrease in demand for line pipe and oil-country goods on account of the arrival of winter, but up to date the demand has shown some increase. In tin plate, part of the production now is against shipments to be made in the first quarter of the new year. Pipe mills and tin plate mills are operating at about 70 per cent of capacity.

Production of steel in general is probably not much above 40 per cent capacity. Steel prices now show scarcely any sagging tendency.

Pig Iron—Quotable prices are unchanged, at $20 for bessemer, $19 for basic, and $20.50 for foundry, f.o.b. Valley furnaces, $1.96 freight to Pittsburgh, but producers frankly state that these prices would probably be shaded if any important demand were to develop. W. P. Snyder & Co. report average prices for November of $20 for bessemer and $19 for basic, based on actual tonnage. The average quoted price on foundry was $20.78.

Coke

Connellsville—Furnace, $3.35@$3.50; foundry, $4.25@$4.75 per ton.

COMPANY REPORTS

Burma Corporation, Ltd.

The first annual report, for 1920, of operations of the Burma Corporation, Ltd., which has taken over Burma Mines, Ltd., states that a gross profit of £455,516 3s. 5d. was made, and a net profit of £246,770 7s. 4d. carried to surplus. Production amounted to 23,821.14 tons of refined lead and 2,869,727 oz. of silver. Profit and loss account follows:

Operating expenditure:	£	s.	d.
Ore extraction and transport	101,257	11	3
Treatment	402,174	15	5
Freight, shipping and realization charges on lead and silver	135,014	9	3
Salaries and wages	24,955	1	3
Maintenance of roads, bridges, buildings and telephone services	18,208	13	7
Hospital and sanitation	9,428	16	11
Miscellaneous	28,320	8	1
	£719,359	15	9
Mine development	12,220	17	2
Reports and experimental expenses	2,494	17	7
Prospecting, exploration and surveying	3 212	18	0
Head office expenses	8,286	8	5
London representative's office	5,666	6	4
Balance carried to appropriation account	455,516	3	5
	£1,206,757	6	8

	£	s.	d.
Lead and silver sales	1,081,380	16	6
Lead and silver on hand	111,096	15	11
Sundry profits and receipts	13,972	3	7
Transfer fees	307	10	8
	£1,206,757	6	8

APPROPRIATION ACCOUNT	£	s.	d.
Interest	10,715	19	11
Interest on first mortgage 8 per cent convertible debenture stock	9,644	14	4
Debenture trustees' fees	33	6	8
Loss on realization of 5 per cent war loan stock	7,022	3	4
Depreciation on machinery, plant and railway	95,018	19	2
Preliminary expenses and cost of issue of debenture stock, including Rs. 5,000,000 underwriting commission wholly written off	46,835	6	3
Income and super tax	39,475	6	5
Balance, being net profit carried to balance sheet	246,770	7	4
	£455,516	3	5
Balance brought down from profit and loss account for year ended Dec. 31, 1920	455,516	3	5
	£455,516	3	5

Burma Corporation, Ltd., is capitalized at Rs. 20,000,000 of Rs. 10 each, of which 13,541,689 shares have been issued, valued at £9,027,792 13s. 4d. A first mortgage of 8 per cent convertible debenture stock to the value of £1,000,000 is outstanding.

The directors have decided that the future policy to be adopted must be capable of being carried out by the company on its existing resources, which made it necessary:

1. To close up the construction of the zinc works in India, as financial considerations prevented the government of India contributing the anticipated loan and the Tata Iron & Steel Co. desired to limit its participation.

2. To discontinue the erection of the new lead smelter and to rely upon the extension and improvement, at a much smaller cost, of the existing smelter.

3. To suspend for the time being all further expenditure on the development of the Namma coal field.

The present programme now in operation is based on an annual output of 45,000 tons of refined lead and 4,500,000 oz. of silver, requiring a daily output of 700 tons of ore.

The directors are satisfied that this program of operations can be carried out within the corporation's own financial resources and without any additional issues of shares or debentures. The completion of the new program will reduce the capital claims on the company's resources and enable the board to devote surplus funds to dividends.

Ore reserves at the end of 1920 were 4,429,458 tons, assaying 23.2 oz. of silver per ton, 25.3 per cent lead, and 17.7 per cent zinc. Included in the above are 335,861 tons of ore carrying 11 per cent copper.

Burma Mines, Ltd.

A report of operations of Burma Mines, Ltd., for 1919 shows a net profit of £54,823 19s. The following table shows production, (1920 and 1918 also included):

	1920	1919	1918
Tons material smelted	136,450.20	105,559.58	116,343.87
Lead contents, tons	40,348.01	29,647.50	26,300.49
Silver contents, ounces	3,646.10	2,764,700.00	2,477,314.00
Zinc contents, tons	21,149.80	16,995.00	10,936.00
Hard lead produced, tons	28,484.70	21,228.60	21,196.70
Refined lead produced, tons	23,821.14	18,545.06	18,641.84
Fine silver, ounces	2,869,727.24	2,164,856.00	1,970,614.00
Coke used, tons	18,333.50	15,192.80	16,578.30
Coke used per cent of hard lead	64.30	71.50	78.2

Profit and loss account follows:

Operating expenditure	£	s.	d.	£	s.	d.
Ore extraction, slag recovery and transport expenditure	69,442	4	0			
Treatment	318,082	13	10			
Freight, shipping and realization charges on lead and silver	167,493	1	10			
Salaries and wages	31,373	3	7			
Maintenance of road, bridges, buildings and telephone service	18,855	18	2			
Miscellaneous	29,493	13	4			
				634,740	15	9
Experimental and reasearch expenditure				9,420	11	8
Mine development				15,712	6	11
Prospecting and exploration				9,890	16	2
Monochang Exploration Co., Ltd:						
Shares and expenditure written off				20,681	15	4
Exchange				31,893	15	7
Balance of interest, Burma and London				3,694	8	1
General expenses, London				16,162	16	3
Burma Corporation, Ltd.—Debenture interest				103	2	2
Burma Corporation, Ltd.—Directors' fees				448	15	0
Depreciation on buildings, plant, machinery, railway and rolling stock				103,228	3	4
Balance carried to appropriation account				159,768	2	5
				£1,005,745	7	8

	£	s.	d.
Lead and silver sales	866,367	8	8
Lead and silver on hand in Burma	135,524	1	3
Sundry profits and receipts	3,850	18	9
Transfer fees	3	0	0
	£1,005,745	8	8

APPROPRIATION ACCOUNT	£	s.	d.
Amount payable to Burma Corporation, Ltd, Oct. 16, 1919, under agreement dated May 29, 1914	94,944	3	5
Provision for income tax	10,000	0	0
Balance carried to balance sheet	54,823	19	0
	£159,768	2	5
Balance from profit and loss account	159,768	2	5
	£159,768	2	5

The company is capitalized at £200,000, of which 724,577 shares at 4s. each have been issued. Balance as per account for 1918 was £72,405 19s. 4d. Adding profit of £54,823 19s. gives a balance of £127,229 18s. 4d.

Burma Mines, Ltd., operates one of the largest silver-lead mines in the world. Ore reserves on Jan. 1, 1920, were estimated at 4,493,143 tons, containing 107,260,848 oz. of silver, 1,156,121 tons of lead, 806,758 tons of zinc, and 53,729 tons of copper.

Burma Mines, Ltd., was taken over by Burma Corporation, Ltd., on Dec. 17, 1919, the consideration being £768,163 0s. 4d.

Mount Lyell Mining & Ry. Co., Ltd.

A cable advice from Melbourne, Australia, from the Mount Lyell Mining & Ry. Co. to the London office states that ore smelted during the year ended Sept. 30 last was: Mount Lyell mine, 93,107 tons; North Mount Lyell mine, 45,235 tons; total, 138,342 tons; also concentrates, 14,343 tons. Produced, 5,786 tons of blister copper, containing copper, 5,738 tons; silver, 178,380 oz.; and gold, 4,744 oz. Recent increased output due to modifications of treatment methods, assisted by higher grade of ore treated from the North Mount Lyell mine, has lowered cost of production.

Application is now before Commonwealth Court of Conciliation and Arbitration for a reduction of mining wages

to agree more nearly with the reduced cost of living figures. Operations for the year have resulted in a net profit of £51,830, after writing off depreciation £48,590 and prospecting and development expenditure of £4,459. Credit balance to profit and loss account was £269,454; and liquid assets in excess of liabilities, £472,455. The directors regret that under the present circumstances payment of a dividend is impossible.

Ore reserves are as follows: Mount Lyell mine, including South Mount Lyell mine, based on previous figures, 1,711,088 tons; North Mount Lyell mine, newly calculated, 1,095,981 tons. Diamond drilling indicates important accession to ore reserves. At the concentration plant, hand sorting started in January and equals expectations. The flotation plant treated 60,639 tons of ore and produced 15,083 tons of concentrates, assaying 15.9 per cent copper. Output from the chemical works at Yarraville and Fremantle was about as usual. It has become necessary to begin the replacing of one of the acid units at the works at Yarraville. The outlook is gratifying for the coming wheat season.

Production of Gold and Silver in the United States in 1920

The Bureau of the Mint, with the co-operation of the Geological Survey, has issued the following statement of the final compilation of the production of gold and silver in the United States during the calendar year 1920:

UNITED STATES GOLD AND SILVER PRODUCTION FOR 1920

State or Territory	Gold		Silver	
	Ounces	Value	Ounces	Value (*a*)
Alaska	412,915	$8,535,700	822,410	$903,2285
Alabama	10	200	5	4
Arizona	240,032	4,961,900	5,431,637	5,965,406
California	716,477	14,810,900	1,654,653	1,817,252
Colorado	363,218	7,508,400	5,166,873	5,674,624
Georgia	34	700	4	3
Idaho	22,668	468,600	7,364,785	8,088,523
Illinois	.....	.....	8,625	9,474
Massachusetts	10	200	1,160	1,275
Michigan	.....	.....	511,664	561,940
Missouri	14	300	123,094	135,196
Montana	91,802	1,897,700	13,263,356	14,566,749
Nevada	175,451	3,626,900	7,481,866	8,217,109
New Mexico	21,720	449,000	699,745	768,509
North Carolina	54	1,100	10	11
Oregon	49,714	1,027,700	101,658	111,648
Pennsylvania	.....	.....	90	99
South Carolina	14	300	1	1
South Dakota	209,842	4,337,800	87,623	96,234
Tennessee	285	5,900	107,250	117,790
Texas	5	100	522,818	574,195
Utah	102,975	2,128,700	11,755,411	12,910,615
Washington	7,160	148,000	177,758	195,226
Wyoming	10	200	56,959	62,556
Philippines	61,756	1,276,600	22,118	24,292
Totals	2,476,166	$51,186,900	55,361,573	$60,801,955

(*a*) Valued at $1.09827 per ounce, being the average of the New York price to the end of May, when the Pittman Act price of $1 per ounce became effective, thereafter the price provided by that act (of April 23, 1918) being used.

Reduction is indicated of both gold and silver as compared with 1919, the differences being on gold, $9,146,500, and on silver, 1,320,872 ounces.

Mining Dividends for November, 1921

The following dividends were paid by mining companies during November, 1921:

Companies in the United States:	Situation	Per Share	Totals
Chief Consolidated, s.l.	Utah	$0.05 Q	$44,201
Colorado Fuel & Iron, pfd.	Col., N.M., Wyo.	2.00 Q	40,000
Eureka Hill, s.l.	Utah	1.00 K	10,000
Homestake Mining, g.	S. D.	0.25 M	62,790
International Nickel, pfd.	N. J., Ont.	1.50 Q	133,689
Miami Copper	Ariz.	0.50 Q	373,557
New Jersey Zinc	N. J.	2.00 Q	840,000
United Verde Ext., c.	Ariz.	0.25 Q	262,500
Companies in Canada and Mexico:			
Amparo Mining, g.s.	Mex.	$0.04 QX	$80,000
Hollinger Consol. Gold	Ont.	0.05 4 wks.	246,000
Lake Shore, g.	Ont.	0.02 Q	40,000

K, irregularly; M, monthly; Q, quarterly; X, includes extra of 1½c.; g., gold; s., silver; l., lead; c., copper.

The dividend list shows little change. It is probable that Bunker Hill & Sullivan is continuing its monthly dividend of 25c., but that company refuses to report dividends to the press. Eureka Hill, of Tintic, again enters the dividend column, making a small distribution from profits due to royalties and rentals. International Nickel paid its dividend out of surplus, as its properties are closed down and expected to remain so for some time. United Verde Extension resumes its usual quarterly distribution, omitted in August, no doubt because of the improvement in the copper market. Its properties remain closed down.

Ore and Metal Movements for October, 1921

Imports and exports of the more important metals and ores, as reported to the Department of Commerce for October, 1921, and the figures for October, 1920, as finally revised, are as follows:

IMPORTS FOR OCTOBER, 1920 AND 1921
In Pounds Unless Otherwise Stated

	October, 1920	October, 1921
Antimony ore, contents	32,452	.....
Antimony matte, regulus or metal	1,621,529	1,540,470
Copper		
Ore, contents	2,628,987	7,824,656
Concentrates, contents	6,560,428	168,966
Matte and regulus, contents	437,087	451,929
Imported from, in part		
Spain	.....	271,555
Canada	1,455,614	226,425
Mexico	2,740,003	443,389
Chile	1,632,738	3,924,383
Peru	1,387	1,813,887
Unrefined, black and blister	14,347,663	23,360,893
Refined, in bars and plates	9,127,567	534,584
Old, for remanufacture	99,293	203,141
Composition metal, copper chief value	985,240	23,400
Lead		
Ore, contents	961,092	842,995
Bullion, contents	2,488,556	17,611,601
Imported from, in part		
Canada	579,630	1,200
Mexico	2,870,018	18,273,846
Other countries	.....	179,550
Pigs, bars and old	20,652,897	1,969,187
Manganese ore, long tons	44,700	36,760
Imported from, in part		
Cuba, long tons	14	34
Brazil, long tons	26,100	35,700
British India, long tons	7,988	1,000
Tungsten ore, long tons	24	54
Pyrites, long tons	16,908	13,381
Imported from		
Spain, long tons	11,308	6,381
Canada, long tons	5,600	7,000
Tin ore, long tons	1,466	148
Tin bars, blocks and pigs	6,741,331	4,351,541
Imported from, in part		
United Kingdom	1,623,788	541 876
British Straits Settlements	3,545,977	3,663,882
Dutch East Indies	280,233	112,183
Australia	235,200	33,600
Zinc		
Ore, contents	1,571,458	.....
Imported from		
Canada	67,000	.....
Mexico	1,504,458	.....

EXPORTS OF COPPER, LEAD AND ZINC
In Pounds

	October, 1920	October, 1921
Copper		
Refined, in ingots and bars	19,270,781	50,661,282
Exported to		
Belgium	1,040,990	3,539,245
France	5,531,926	8,463,472
Germany	3,263,094	15,455,089
Italy	56,060	2,499,506
The Netherlands	1,063,357	3,475,328
Spain	.....	224,056
Sweden	561,415	986,967
United Kingdom	4,423,793	449,047
Canada	1,084,171	4,738
Japan	.....	9,676,855
Other countries	2,245,975	5,886,979
Composition metal, copper chief value	3,891	1,524
Old and scrap	64,928	.....
Pipes and tubes	671,346	98,019
Plates and sheets	686,418	278,258
Wire, except insulated	2,604,500	462,603
Lead		
Pigs and bars		
Produced from domestic ore	299,967	101,600
Produced from foreign ore	448,178	4,884,650
Exported to		
France	224,078	.....
United Kingdom	.....	1,344,596
Canada	500	2,345
Brazil	233,662	246,519
China	94,843	.....
Japan	.....	1,568,000
Other countries	195,062	1,824,790
Zinc		
Dross	147,820	300
Produced from domestic ore	1,423,067	196,489
Produced from foreign ore	830,000	.....
Exported to, in part		
Canada	.....	8,306
Mexico	214,331	1,842
Japan	.....	179,222
Other countries	531,995	7,119
In sheets and strips	1,235,753	426,394

MINING STOCKS

Week Ended December 3, 1921

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	57⅞	56½	57½	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	3¼	2⅝	3		
Allouez	Boston	24⅛	24	24	Mar. '19	1.00
Anaconda	New York	47	45⅝	46⅞	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3½	3	3		
Ariz. Com'l	Boston	9⅛	8⅛	8⅞	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*30	*28	*30		
Bingham Mines	Boston	13¼	13	13	Sept. '19, Q	.25
Calumet & Arizona	Boston			53¾	Sept. '21 Q	.50
Calumet & Hecla	Boston	269	250	250	June '20, Q	5.00
Canada Copper	N. Y. Curb	*30	*28	*28		
Centennial	Boston	9⅛	9	9⅛	Dec. '18, SA	1.00
Cerro de Pasco	New York	34⅜	33⅛	34	Mar. '21, Q	.50
Chile Copper	New York	13⅛	12⅜	12¾		
Chino	New York	27⅛	26⅛	27	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	*13½	*10	*10		
Con. Arizona	N. Y. Curb			*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅜	1⅛	1⅛		
Copper Range	Boston	39½	36⅝	38⅛	Sept. '20, Q	.50
Crystal Copper	Boston Curb	*41	*38	*38		
Davis-Daly	Boston	7	6⅛	6⅞	Mar. '20, Q	.25
East Butte	Boston	11	10⅛	10⅝	Dec. '19, A	.50
First National	Boston Curb	*90	*75	*85	Feb. '19, SA	.15
Franklin	Boston	2¼	2	2		
Gadsden Copper	Boston Curb	†*50	†*40	*45		
Granby Consol.	New York	30	26	26⅞	May '19, Q	1.25
Greene- Cananea	New York	27	25	26⅛	Nov. '20, Q	.50
Hancock	Boston	†2⅜	†2	2⅛		
Howe Sound	N. Y. Curb	2⅜	2⅛	2⅜	Jan. '21, Q	.05
Inspiration Consol.	New York	38⅛	37⅛	38⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7⅜	7	7	Sept. '20, K	.25
Isle Royale	Boston	24	22⅛	24	Sept. '19, SA	.50
Kennecott	New York	25⅝	24⅜	25⅜	Dec. '20, Q	.50
Keweenaw	Boston	1⅝	1⅛	1⅛		
Lake Copper	Boston	3	2⅞	2⅞		
La Salle	Boston	2	1¾	1⅞		
Magma Chief	N. Y. Curb			*8		
Magma Copper	N. Y. Curb	22	21	21⅛	Jan. '19, Q	.50
Majestic	Boston Curb	*5	*5	*5		
Mason Valley	Boston	1⅜	1⅜	1⅜		
Mass Consolidated	Boston	2⅜	2⅛	2⅛	Nov. '17, Q	1.00
Miami Copper	New York	26	25⅜	26	Nov. '21, Q	.50
Michigan	Boston	†2⅜	†2	2		
Mohawk	Boston	56⅛	54⅜	56⅛	Nov. '20, Q	1.00
Mother Lode Con.	N. Y. Curb	5⅞	5⅛	5⅛		
Nevada Consol.	New York	14⅜	13⅛	13⅞	Sept. '20, Q	.25
New Cornelia	Boston	17⅛	16⅛	16⅜	Aug. '20, K	.25
North Butte	Boston	13⅛	12⅛	12⅜	Oct. '18, Q	.25
North Lake	Boston	*20	*20	*20		
Ohio Copper	N. Y. Curb	*12	*9	*10		
Old Dominion	Boston	25⅞	25⅛	25⅛	Dec. '18, Q	1.00
Osceola	Boston	31⅛	31	31	June '20, Q	.50
Phelps Dodge	Open Mar.	†185	†175	....	Oct. '21, Q	1.00
Quincy	Boston	43	42	42	Mar. '20, Q	1.00
Ray Consolidated	New York	14⅜	14⅛	14⅜	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*23	*20	*20		
St. Mary's Min. Ld.	Boston	44⅛	42	44	June '20, K	2.00
Seneca Copper	Boston			24⅛		
Shannon	Boston	1⅛	1⅛	1⅛	Nov. '17, Q	.25
Shattuck Arizona	New York	7⅛	6⅝	7⅛	Jan. '20, Q	.25
South Lake	Boston	†1	†*60	*62		
Superior & Boston	Boston	1 1/16	1⅛	1⅛		
Tenn. C. & C. cfs.	New York	10⅝	10	10	May '18, I	1.00
Tuolumne	Boston	*85	*43	*70	May '13	.10
United Verde Ex.	Boston Curb	29	27⅜	28⅛	Nov. 21, Q	.25
Utah Consol.	Boston	2⅛	2	2	Sept. '18,	.25
Utah Copper	New York	60¼	58⅛	59⅛	June '21 Q	.50
Utah Metal & T.	Boston	1⅜	1⅛	1⅜	Dec. '17,	.30
Victoria	Boston	1⅜	1⅜	1⅜		
Winona	Boston	*50	*40	*50		
Wolverine	Boston	12	11⅜	11⅜		
NICKEL-COPPER						
Internat. Nickel	New York	12⅛	11⅝	12	Mar. '19,	.50
Internat. Nickel, pf.	New York	70	70	70	Nov. '21, Q	1.50
LEAD						
National Lead	New York	81⅛	80⅛	80⅛	Sept. '21, Q	1.50
National Lead, pfd.	New York	107	105⅞	106⅞	Sept. '21, Q	1.75
St. Joseph Lead	New York	14⅛	13⅜	14⅛	Sept. '21, Q	.25
QUICKSILVER						
New Idria	Boston	†*50	†*35	*40		
ZINC						
Am. Z. L. & S.	New York	11⅛	11	11⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	36	35¼	35¼	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅛	5⅛	5⅛	June '18,	.50
Butte & Superior	New York	17⅛	16⅛	17	Sept. '20,	1.25
Callahan Zn-Ld	New York	7⅛	5⅛	6	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	124	124	124	Nov. '21 Q	2.00
Yellow Pine	Los Angeles	*40	*39	*40	Sept. '20, Q	.03

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1	⅞	⅞		
Carson Hill	New York	15⅛	11⅛	11⅞		
Cresson Consol. G.	N. Y. Curb	2⅛	2 7/16	2⅛	June '20, Q	$0.10
Dome Extension	Toronto	*71	*71	*71		
Dome Mines	New York	19½	19	19¼	Oct. '21, Q	.25
Florence Goldfield	N.Y. Curb	*45	*25	*36		
Golden Cycle	Colo. Springs	*80½	*77	*78	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*3	*3	Dec. '19,	.05
Hollinger Consol.	Toronto	7.80	7.70	7.80	Dec. '21, 4 wks.	.05
Homestake Mining	New York	55	55	55	Nov. '21, M	.25
Kirkland Lake	Toronto	*33	*31½	*32		
Lake Shore	Toronto	1.23	1.18	1.21	Nov. '21, K	.02
McIntyre-Porcupine	Toronto	1.98	1.91	1.96	Sept. '21, K	.05
Porcupine Crown	Toronto	*15	*13½	*14	July '17,	.03
Porcupine V. N. T.	Toronto	*18	*15½	*17½		
Portland	Colo. Springs	*40	*33	*40	Oct. '20, Q	.01
Schumacher	Toronto	*26½	*24	*24½		
Silver Pick	N. Y. Curb	*7	*7	*7		
Teck Hughes	Toronto	*15½	*15	*15½		
Tom Reed	Los Angeles	*38	*36	*37	Dec. '19,	.02
United Eastern	N. Y. Curb	2 1/16	2⅛	2 1/16	Oct. '21, Q	.15
Vindicator Consol.	Colo. Springs	*22½	*22	*22½	Jan. '20, Q	.01
White Caps Mining	N. Y. Curb	*6	*6	*6		
Yukon Gold	N. Y. Curb	1 1/16	1 1/16	1 1/16	June '18,	.02½
SILVER						
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*25	*21	*23	May '20, K	.03
Coniagas	Toronto	1.50	1.15	1.25	May '21, Q	.12½
Crown Reserve	Toronto	*11	*9	*10	Jan. '17,	.05
Kerr Lake	N. Y. Curb	3½	3⅛	3⅛	Oct. '21, Q	.12½
La Rose	Toronto	*33½	*31½	*33½	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*17	*14	*17	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.15	1.05	1.10	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	6¾	6⅛	6⅛	Oct. '21, Q	.03
Ontario Silver	New York	4¼	4	4¼	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	.10
Temiskaming	Toronto	*27	*25	*27	Jan. '20, K	.04
Trethewey	Toronto	*10½	*8	*9½	Jan. '19,	.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*84	*80	*80		
Cash Boy	N. Y. Curb	*7	*4	*7		
Consol. Virginia	San Francisco	†66	†65	....		
Dolores Esperanza	N. Y. Curb	1⅛	1⅛	1⅛		
El Salvador	N. Y. Curb	*11	*10	*10		
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	.05
Louisiana Con.	N. Y. Curb			⅛		
MacNamara M.& M.	N. Y. Curb	*13	*11	*13	May '10,	.02½
Tonopah-Belmont	N. Y. Curb	1⅛	1 1/16	1 1/16	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	*67	*60	*61		
Tonopah-Extension	N. Y. Curb	1 1/16	1 1/16	1 1/16	Oct. '21, Q	.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1⅛	Oct. '21, SA	.05
West End Consol.	N. Y. Curb	*88	*81	*81	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake			*92	Dec. '20,	.15
Chief Consol.	Boston Curb	3⅛	2⅞	2⅞	Aug. '21, Q	.05
Consol. M. & S.	Montreal	18⅜	18	18⅛	Oct. '20, Q	.62½
Daly Mining	Salt Lake		†1.00		July '20, Q	.10
Daly-West	Boston	†2	†1⅛	1⅛	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	†3	†2⅛	2⅛	Apr. '21, K	.05
Electric Point	Spokane	*4	*3	*3	May '20, SA	.03
Eureka-Croesus	N. Y. Curb	*33	*26	*31		
Federal M. & S.	New York	9⅛	9⅛	9⅛	Jan. '09,	1.50
Federal M. & S. pfd	New York	34⅛	31⅛	31⅛	Sept. '21, Q	1.00
Florence Silver	Spokane	*12	*11	*12	Apr. '19,	.01½
Grand Central	Salt Lake		†*21		June '20, K	.03
Hecla Mining	N. Y. Curb	4⅛	4⅛	4⅛	Sept. '21, Q	.10
Iron Blossom Con.	N. Y. Curb	*21	*19	*20	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	†3.00	†2.00	....	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*4	*4	*4	June '21, I	.02
Prince Consol.	Salt Lake	*6½	*6	*6½	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*3	*1½	*3	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*8	*8	*8		
South Hecla	Salt Lake	†*50	†*20	....	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	*10	*10	*10	Oct. '17,	.05
Stewart Mining	N. Y. Curb	*3	*3	*3	Dec. '15	.05
Tamarack-Custer	Spokane	1.95	1.90	1.95	Jan. '21 K	.04
Tintic Standard	Salt Lake	2.02½	1.95	2.00	July '21, Q	.05
Utah Apex	Boston	3⅛	3⅛	3	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	.01
VANADIUM						
Vanadium Corp.	New York	33⅜	30⅛	33	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	59	55	58½	Oct. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	†79½	....	79½	Oct. '21, Q	1.75
SULPHUR						
Freeport Texas	New York	15⅛	15	15⅛	Nov. '19, Q	1.00
Texas Gulf	New York	35¼	32⅛	34		
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	43⅜	41⅜	43⅜	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	87⅛	84⅜	87⅛	Dec. '21, Q	1.75
Am. Sm. pf. A	New York	88	88	88	Oct. '21, Q	1.50
U. S. Sm. R. & M.	New York	34½	34	34	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	New York	42½	42¼	42½	Oct. '21, Q	.87½

*Cents per share. †Bid or asked. Q, Quarterly SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.